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QUALITY ASSURANCE PROJECT PLAN
REMEDIAL INVESTIGATION

MIDWAY LANDFILL
Kent, Washington
B&V Project 11889.401

June 25, 1986

State of Washington
Department of Ecology

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Black & Veatch
Engineers-Architects

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Midway
10/22/86
NEF

Authorization Page

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATION
Midway Landfill
Kent, Washington

Ecology No.: C-85075

Prepared By: Black & Veatch

Date: June 25, 1986

Approvals (Acknowledgement):	Date:
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List of Abbreviations

<u>English</u>

ASTM	American Society for Testing and Materials
B&V	Black & Veatch
C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeter
COE	Corps of Engineers
DCO	Document Control Officer
DO	Delivery Order (for ordering sample containers from SBRS)
DOT	US Department of Transportation
Ecology	State of Washington Department of Ecology
e.g.	such as, for example
EIS	environmental impact statement
EM	electromagnetic
EMT's	Emergency Medical Technicians
EPA	US Environmental Protection Agency
etc.	and others
F	Fahrenheit
FPD	Forward Planning Document
FS	Feasibility Study
ft	foot

List of Abbreviations (Cont'd)

gal	gallon
GC	gas chromatograph
GPR	ground penetrating radar
H&A	Hall & Associates
HC	Hart-Crowser & Associates Inc.
HC1	hydrochloric acid
HNO_3	nitric acid
HNu	Instrument that measures heavy hydrocarbon concentration in vapor phase (butane plus, aromatics)
H_2SO_4	sulfuric acid
HWRAS	Hazardous Waste Remedial Action Section of the WDOE
I.D.	inner diameter
IDLH	Immediately Dangerous to Life and Health
i.e.	that is
in.	inch
IRM's	Initial Remedial Measures
kg	kilogram
l	liter
lb	pound
LEL	lower explosive limit
m	meter
mg	milligram
ml	milliliter
mm	millimeter

List of Abbreviations (Cont'd)

mmhos	millimhos
MBE	Minority Business Enterprise
MS	mass spectrograph
MSHA	Mine Safety and Health Administration
NaOH	sodium hydroxide or caustic soda
$Na_2S_2O_3$	sodium thiosulfate
NBS	National Bureau of Standards
NEIC	National Enforcement Investigations Center (EPA)
NIOSH	National Institute Occupational Safety and Health
NPL	National Priority List of hazardous waste sites selected for CERLA Program (Superfund)
NPO	National Project Office
No.	Number
NOEL	No Observed Effect Level
n.o.s.	not otherwise specified
ORM-A	Other Regulated Materials - Series A
oz	ounce
OVA	organic vapor analyzer
p	page
PCB	polychlorinated biphenyls
pH	negative logarithm of hydrogen ion concentration
PL	packing list
PO	Project Officer
pp	pages
ppm	parts per million

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State of Washington
Department of Ecology
Midway Landfill Remedial Investigation

B&V Project 11889.401
June 30, 1986

State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504

Attention: Mr. Dan Swenson, Project Manager

Reference: Ecology Contract No. C0085075
Work Assignment MDLF-2

Gentlemen:

In accordance with Task 1.5 of the referenced assignment, we have transmitted under separate cover two (2) copies of the "Quality Assurance Project Plan, Remedial Investigation, Midway Landfill, Kent, Washington," dated June 25, 1986.

As you suggested earlier, future revision of the QAPP necessitated by changes in the City of Seattle's project team RI activities is expected to be performed by Black & Veatch. Your assessment is correct that effort will be saved by revising one QAPP and ensure that the document is maintained in compliance with the intent of the RI sampling plan design and current Ecology and EPA QA guidance. Given that B&V is expected to maintain the RI QAPP, we have not identified sections or appendices which are proprietary to B&V and which have not been produced under direct funding from Ecology.

Very truly yours,

BLACK & VEATCH

Mark G. Snyder
Program Engineer

MGS:gcb

cc: J. Swanberg, Ecology Contract Officer
P. B. MacRoberts/Project File (w/enclosure)
T. F. Rogers
W. G. Smith (w/enclosure)

List of Abbreviations (Cont'd)

PSA	Phoenix Safety Association
PTD	Programmed Thermal Desorber
PVC	polyvinylchloride
PWP	Project Work Plan
QA	Quality Assurance
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAMS	Quality Assurance Management Staff
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance and Quality Control
QC	Quality Control
qt	quart
RAR	Repository Authorized Requester
RAS	Repository Authorized Service
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RSCC	Regional Sample Control Center
SAS	special analytical services
SBRS	Sample Bottle Respository Service
SCBA	Self Contained Breathing Apparatus
SMO	Sample Management Office of the EPA
SNARL	Suggested No Adverse Response Levels
SOP	Standard Operating Procedures

List of Abbreviations (Cont'd)

SOW	Scope of Work
SPM	Site Project Manager
STEL	Short Term Exposure Limits
TCA	trichloroethane and isopropyl alcohol mixture
TDS	total disolved solids
TLV	Threshold Limit Value
TOC	total organic carbon
TSCA	Toxic Substance Control Act
U.S.	Federal Government of the United States of America
USC	Unified Soils Classification
VOA	volatile organic analysis
vol.	volume
WBE	Women Business Enterprise
WDOE	State of Washington Department of Ecology
WDOT	State of Washington Department of Transportation

<u>Greek Letters</u>

μg	microgram

1.0 INTRODUCTION

The Seattle Engineering Department is investigating options for closure of the Midway Landfill under State of Washington solid waste guidelines. As part of this effort, geotechnical and hydrological investigations were performed and alternatives for closure of the site have been developed. The Seattle Engineering Department has installed an onsite gas control system consisting of perimeter gas extraction wells and gas flares, as well as several boreholes for gas monitoring, and ground water monitoring wells. Currently, the Remedial Investigation/Feasibility Study for closure of the landfill has progressed such that the Forward Planning Document, a Project Work Plan, and a Sampling Plan have been prepared. The preparation of a Quality Assurance Project Plan is the next logical progression of activity.

An important part of an effective multidisciplinary field investigation is a definitive Quality Assurance Project Plan (QAPP) coupled with efficient use of personnel and resources. A comprehensive and well documented quality assurance plan is needed to obtain data that are scientifically and legally defensible and to achieve the required levels of precision and accuracy with a minimal expenditure of resources.

This plan outlines the major Quality Assurance/Quality Control (QA/QC) objectives and requirements for field investigations to support the Remedial Investigation (RI) for the State of Washington Department of Ecology (Ecology) of the Midway Landfill in Kent, Washington. The plan complies with the outline developed under the auspices of Ecology's Quality Assurance (QA) Program Plan and follows EPA guidelines contained in Document QAMS-005/80. The plan was prepared under Contract C-85075 for Ecology. As the project proceeds, new considerations may need to be addressed and additional guidelines provided in order to maximize the efficiency and quality of the work plan. The QA framework provides for these adjustments and appropriate documentation through periodic reports to Ecology.

2.0 PROJECT DESCRIPTION

2.1 SITE DESCRIPTION

2.1.1 Location

The Midway Landfill is a privately owned landfill that has been operated by the City of Seattle Solid Waste Utility from 1966 to 1983. The site consists of approximately 60 acres, located at South 248th and Pacific Highway South, inside the City of Kent, and is approximately 16 miles south of Seattle. The site is bordered on the east by Interstate 5 and on the south by South 252nd Street. The site was formerly the location of a gravel mining operation and a peat bog lake, Lake Mead. The location of the landfill with respect to Puget Sound and the Green River Drainage System is shown in Figure 2-1.

2.1.2 Geological Conditions

2.1.2.1 Regional Overview. The geology in the area surrounding the Midway Landfill is complex, including deposition of lavas, volcanic debris, and sedimentary material during the Tertiary Period. The Midway Landfill is located in an area consisting primarily of ground moraine deposits. The deposits are unoxidized, compact till, with discontinous covers of sands and gravels. The landfill is located in a localized depression of advance glacial outwash with materials consisting mainly of light-gray sand, sand and gravel, and gravel and cobbles. Intermixed with these materials may be fine sands and laminated silts and clays.

2.1.2.2 Site Specific Conditions. A field investigation of Midway Landfill was conducted for the City of Seattle in 1982 as part of an assessment of the geotechnical and hydrological conditions associated with the site. The landfill overlies the location of a previous gravel mining operation and Lake Mead. The approximate boundaries of the gravel pit and Lake Mead are shown in Figure 2-2. The water from the lake was used to wash silts and clays from the sand and gravel, and was then recycled back into the lake. This resulted in the formation of a

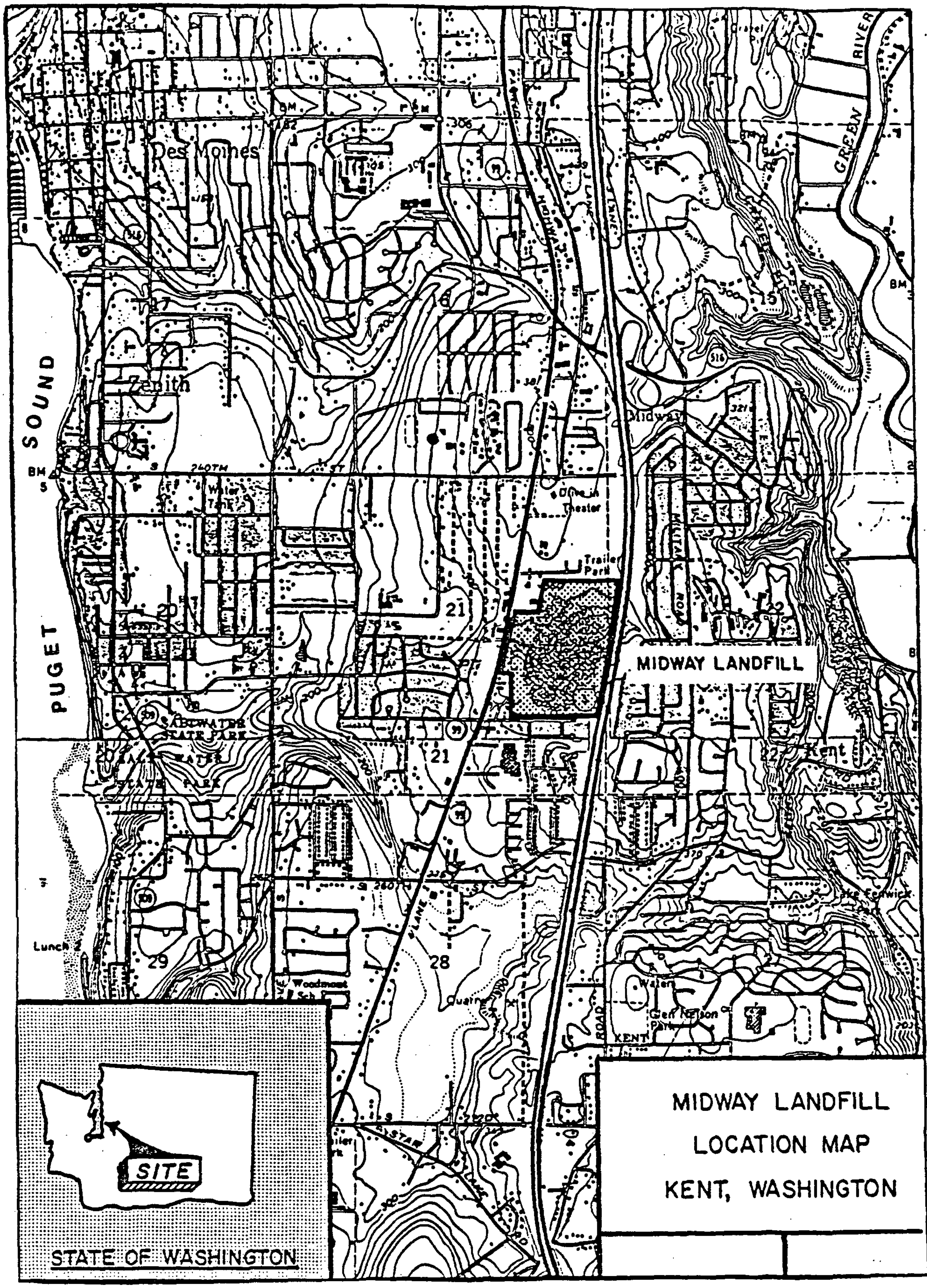

Figure 2-1 Location Map

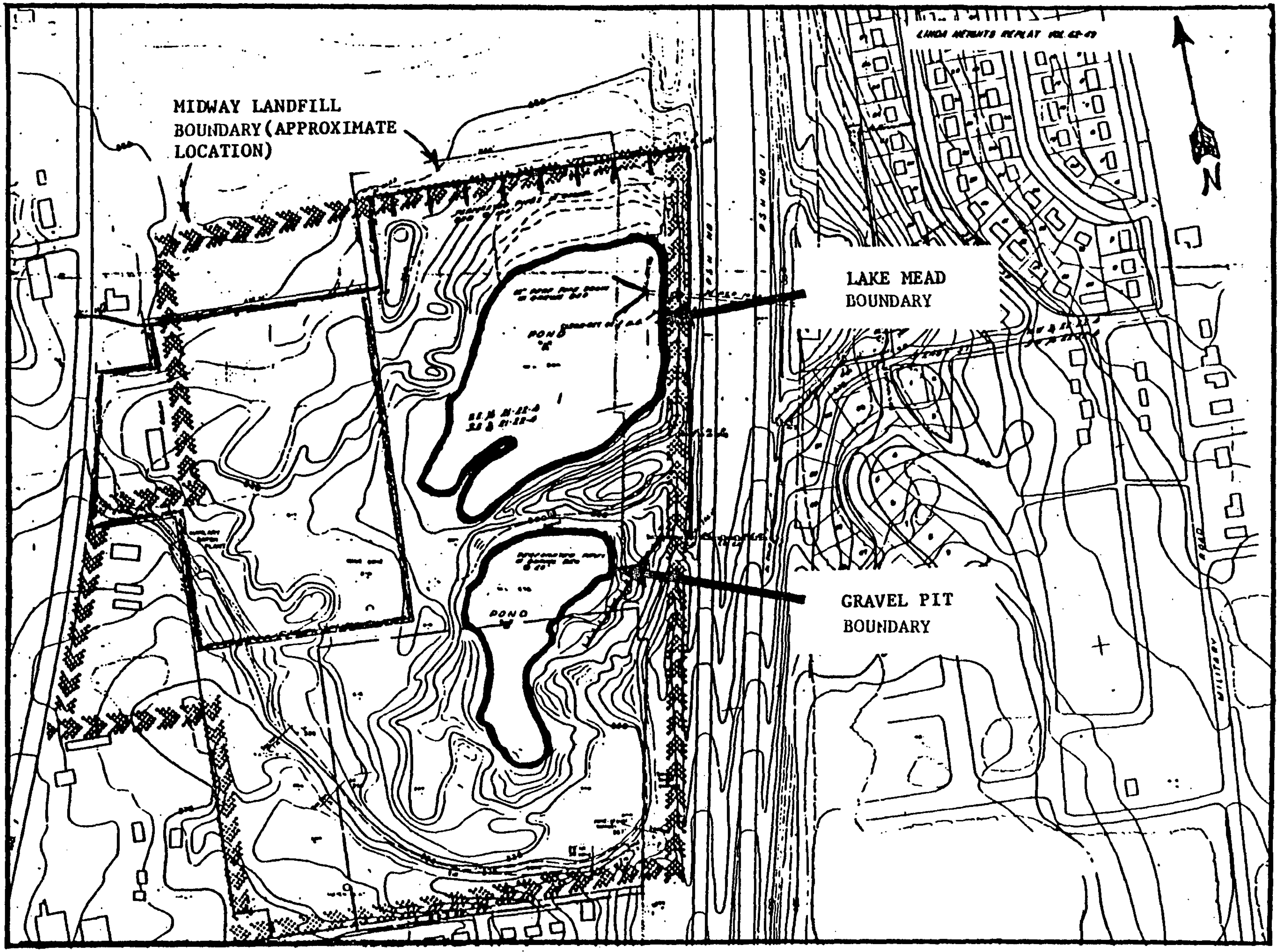

Figure 2-2 Vicinity Map

clay/silt layer on the lake bottom. Near the end of the gravel mining operation, the barrier between the lake and the gravel pit was broken. The water from Lake Mead then entered the gravel pit and the clay/silt was deposited on the pit bottom. However, the landfill extends into areas where the clay/silt was not deposited; the clay/silt layer does not appear to be contiguous under the entire landfill. The stratigraphy of the landfill site consists of the landfill materials underlain by a complex mixture of glacial outwash materials such as gravely sand, clayey sand and gravel, silty sand, sandy gravel, and some clayey silt/silty clay, in addition to the aforementioned clay/silt layer from Lake Mead. In the north section of the landfill, the clay/silt layer overlies peat deposits. Along the western border of the landfill are two different deposits of a gray silt and a silty clay. Based upon the field investigation, it appears that the clay/silt layer deposited from the gravel mining operation has caused the formation of a "perched" water table within the landfill. The areal extent of this water table is not defined at this time.

2.1.3 Soil Characteristics

The Midway Landfill is located in an area consisting primarily of Alderwood gravelly sandy loam and Arents, Alderwood material (6 to 15 percent slope). The Alderwood series are moderately well drained soils that (undisturbed) exhibited weakly to strongly consolidated substratum at depths of 24 to 40 inches. The Arents, Alderwood soils are Alderwood soils that, though similar to the Alderwood series, have been so disturbed by urbanization that they no longer possess the same characteristics. However, a consolidated substratum is occasionally found in the series.

2.1.4 Surface Water

Previous geotechnical and hydrological investigations addressed surface and ground water flow patterns in the area. The landfill is located near the divisional line between the Puget Sound and Green River watersheds; however, rainwater falling near the landfill tends to flow towards Puget Sound. Because the landfill is located in a localized depression, it was surmised that there historically was no drainage out of the site. Currently, the landfill serves as a drainage field for water falling on I-5, and the north pond receives drainage from north of the site, as well as from on site.

There are three ponds located on the property. These ponds receive on and offsite drainage, as well as seeps from the landfill. There is no overland offsite drainage out of the ponds, but the permeable materials underlying them readily allows precolation into the ground water. At this time, the water level in the west pond is controlled by pumping into the north pond. Tank trucks are used to remove the water from the north pond; the water is tested and is discharged either into the Green River, the Metro sewer line, or the leachate treatment pond at the nearby Kent-Highlands landfill. The south pond was drained of its contents prior to March 1984. Water that now enters the south pond leaves by percolation and evaporation. A paved drainage ditch has been placed in a southeast to northwest direction in the landfill, and routes surface water runoff into the north pond.

2.1.5 Ground Water

2.1.5.1 General Conditions. Midway Landfill is located near the division of ground water flow between Puget Sound and the Green River. Ground water flow has been assumed to flow south or southwesterly but existing data are insufficient to develop detailed conclusions.

2.1.5.2 Site Specific Conditions. Field measurements of the static water levels at Midway Landfill were made during the hydrologic investigation. The presence of the shallow clay/silt layer from gravel mining operations complicates the ground water flow pattern within the landfill. During periods of high precipitation, the ponds on the western part of the property seem to force flow in an easterly, then southerly direction. The clay/silt layer appears to create a perched water table. Water level measurements were done on the Linda Heights well, which lies to the east of the landfill. The extent of interconnection between the Linda Heights aquifer and the aquifer below Midway Landfill is not known.

2.1.6 Landfill Gases

The presence of methane and other gases generated during the decomposition process of the landfill materials presents potential threats to human health and the environment at the site. Additionally, there is concern over the possible presence of organic vapors from solvents and other organic compounds allegedly disposed in the landfill. Analysis of gas samples with Draeger tubes have shown hydrogen sulfide, hydrogen cyanide, and volatile organics to be present at Midway Landfill. Although the levels of volatile organics detected during the previous tests are not believed to pose serious health hazards, they do serve as indicators of the types of materials present in the landfill.

2.2 ENVIRONMENTAL CONCERNS

2.2.1 Waste Characterization

The Midway Landfill was initially operated primarily as a non-putrescible landfill receiving mainly demolition and non-putrescible transfer station wastes. However, liquid and solid wastes known or suspected to contain solvents, heavy metals, and hazardous wastes were disposed in the landfill at least from 1979 to 1981. Beginning in 1980, the landfill operators monitored more closely the types of wastes placed into the facility. Between 1980 and 1983 large quanitites of liquid wastes were placed into the landfill. Quantities and types of liquid wastes placed in the landfill from 1980-1982 have been estimated as follows:

- o Paint sludges, alkaline wastes: 320,000 gal
- o Dye and preservative wastewaters from preserving decorative plants: 287,500 gal

- Paint sludge and oily sludge: 450 drums
- Waste coolant: 1,262,500 gal
- Steam cleaning truck wastes: 350,000 gal
- Oily wastewaters: 47 truckloads

Other wastes included:

- Refinery tank bottoms: 3,800 cubic yards
- Lead contaminated wastes: 226 tons

Types of wastes identified from the files included: organics, inorganics, solvents, pesticides, heavy metals, acids, mixed municipal, alkaline, and unknown. Industries from which wastes were accepted included construction, fertilizer, paper/printing, iron/steel foundry, general chemical, plating/polishing, electrical conductors, transformers, utility companies, sanitary/refuse, photofinish, lab/hospital, manufacturing, and unknown.

2.2.2 Surface Water

Surface Water discharging into Midway Landfill is a major concern. Preliminary analysis indicates that surface water discharges from several offsite locations to Midway. Because of the natural terrain of Midway, surface water is contained onsite with no natural discharge. The water then naturally evaporates or feeds the ground water system. Thus, surface water feeds the ground water system beneath the Midway Landfill and probably creates migration of the ground water from Midway to offsite locations.

2.2.3 Ground Water

Previous analysis of ground water samples have verified the presence of many pollutants in the ground water in the Midway Landfill. Many of these pollutants are considered priority pollutants. Table 2-1 lists pollutants identified to date in the ground water at Midway. Since the ground water probably migrates offsite, pollutants in the ground water is a major concern.

TABLE 2-1 POLLUTANTS DETECTED IN GROUND WATER MONITORING WELLS AT MIDWAY LANDFILL

Arsenic	2-methyl phenol	Bis (2-ethylhexyl) phthalate
Barium*	4-methyl phenol	Di-n-butyl phthalate
Benzene	Dibenzofuran	Di-n-octyl phthalate
Boron*	2-methyl naphthalene	Diethyl phthalate
Lead	Acetone	Acenaphthene
Nickel	2-hexanone	Anthracene
Zinc	o-xylene	Fluorene
Chlorobenzene	Gamma BHC	Phenanthrene
1,1-dichloroethane	p-chloro-m-cresol	Pyrene
Chloroethane	Fluoranthene	
1,2-transdichloroethene	1,2-dichlorobenzene	
Ethyl benzene	Naphthalene	
Methylene chloride	N-nitrosodiphenylamine	
Toluene		
Vinyl chloride		

*Non-priority pollutant

2.2.4 Landfill Gases

Analysis of gases from previous borings at the landfill has indicated the presence of hydrogen sulfide, hydrogen cyanide and volatile organics. Volatile organic compounds determined to be coming from Midway Landfill are listed in Table 2-2 along with concentrations found in samples. These concentration levels should not be regarded as absolute values, but they do show presence and relative concentrations.

Combustible gas monitoring at locations near Midway has created particular concern. Combustible gas levels in the explosive range for light hydrocarbons have been detected at several locations. Figure 2-3 shows Midway Landfill's location with respect to residential areas. Of major concern is the location of several businesses located between Midway and the residential areas.

TABLE 2-2 VOLATILE ORGANICS (BY GC/MS) AT MIDWAY LANDFILL

Compound	Concentration, $\mu g/m^3$
Vinyl Chloride	165
Chloroethane	110
Methylene Chloride	600
Acetone	670
1,1-Dichloroethylene	20
1,1-Dichloroethane	740
Trans-1,2-Dichloroethylene	860
2-Butanone	370
1,2-Dichloroethane	300
1,1-1-Trichloroethane	930
1,2-Dichloropropane	50
Trichloroethylene	280
Benzene	440
4-methyl-2-pentanone	3,250
Tetrachloroethylene	320
Toluene	1,600
Ethylbenzene	2,740
Xylene	2,450

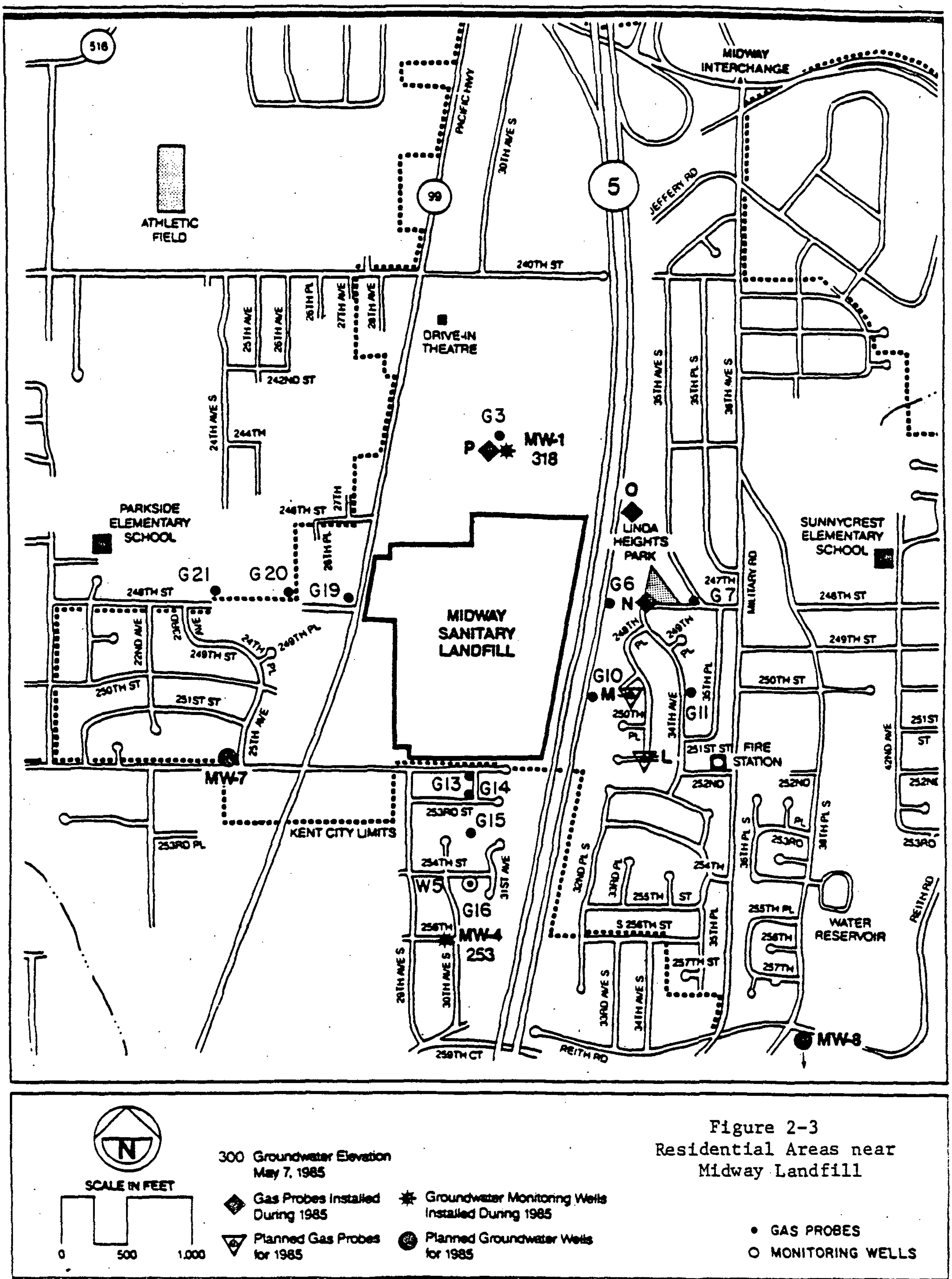

Figure 2-3
Residential Areas near
Midway Landfill

2.3 PURPOSE

The purpose of Phase II of the remedial investigation for Midway Landfill is to obtain sufficient data to identify the magnitude and the extent of contaminant and gas migration and to assess remedial action alternatives. Initial activity will be to assess the extent of gas migration because of the immediate explosive hazard potential to nearby businesses and residences. The collection and review of all data developed during the investigation will be done in a professional, legally defensible manner.

The investigation will consist of activities to be conducted in three major areas: gas migration, hydrogeological investigation (including surface water, ground water, and subsurface geological studies), and an investigation to identify receptors.

2.4 OBJECTIVES

In general, the objectives of the investigation include the following:

- o Identification of the contaminant sources.
- o Determination of the present extent of landfill gas and leachate migration.
- o Determination of the pathways of contaminant migration and transport rates.
- o Characterization of the chemical composition of the landfill gas and leachate plume.
- o Identification of contamination receptors and specific onsite and offsite health and environmental effects.
- o Provision of sufficient data to establish remedial response objectives, identify and evaluate alternatives, develop remedial action design(s), and assess the adequacy of current closure activities.

2.5 FIELD ACTIVITIES

The field activites for Phase II of the Remedial Investigation of Midway Landfill are described in the Sampling Plan in the appendices. The scope of the field activities was developed based on an evaluation of existing information, identification of data gaps, and the identification of the types and extent of data needed to formulate remedial action alternatives. Background information relating to the site and the results of previous sampling and monitoring efforts is summarized in the "Forward Planning Document for Midway Landfill," dated March 7, 1985, prepared by Black & Veatch for the State of Washignton, Department of Ecology.

Field activities will consist of two programs. The first program is a "fast-track" evaluation of the potential hazard associated with migration of landfill gas from Midway. There is strong evidence that migrating gas is a potential explosive hazard for nearby businesses and residences. Tasks to be performed in the field for the "fast-track" portion of the program are:

- o Install shallow gas probes with single sampling level.
- o Install deep gas probes with three sampling levels each.
- o Collect soil samples when drilling gas probes.
- o Measure gas pressure of each well.
- o Analyze gas composition in each well for H_2S, CO_2, and explosive mixture levels.
- o Analyze gas composition in each well for key volatile organics.

The overall program is aimed at defining the overall potential hazard of the landfill and identify corrective action to be taken. Field tasks to accomplish the objectives will be:

- o Conduct a survey of existing wells within one mile of the Midway Landfill.
- o Sample soils near the surface at fifteen offsite locations.
- o Sample surface water and measure rate of influx.

- Drill 17 new ground water wells onsite and offsite.
- Sample soil while drilling wells.
- Sample ground water.
- Install three new leachate wells onsite.
- Install air monitoring stations.
- Collect ground water, surface water, soil, leachate, gas and air samples for analysis.
- Identify population threatened by Midway Landfill.
- Survey elevations and measure levels of ground water for new and existing wells.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The major objective of the Quality Assurance Project Plan (QAPP) is to control the quality of collecting, analyzing, evaluating, and reporting data during the Remedial Investigation. To achieve this goal, the project organization and personnel responsibilities must be clearly defined. The major Quality Assurance (QA) tasks are listed in Table 3-1 and are grouped according to the stages of project planning, data collection, and data reporting. Most QA tasks will be performed by the technical staff of Black & Veatch's project team, but Ecology personnel must review and approve some tasks. Since the project falls under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the cooperative agreement between the US Environmental Protection Agency (EPA) and Ecology requires participation of the US EPA QA personnel in the planning stage. Participation may also be required during data reporting and final review. Figure 3-1 defines the project organization that is responsible to achieve the required quality assurance for the Midway Landfill project.

TABLE 3-1. RESPONSIBILITY FOR MAJOR QA TASKS

	Task	Person Chiefly Responsible
A.	Project Planning	
	1. Establish data QA requirements, Establish level of QA effort.	Ecology QA Officer
	2. Select laboratories and analysis methods.	B&V project scientist or engineer
	3. Write QA project plan.	B&V QA Coordinator
	4. Review QA project plan.	B&V QA Officer, Ecology QA Officer
	5. Review final QA project plan.	EPA Region X QA Officer
B.	Data Collection and Checking	
	1. Audit performance.	B&V QA Coordinator
	2. Maintain equipment (preventive).	Subcontractor Laboratory Supervisor and Field Supervisor
	3. Correct laboratory procedures.	Subcontractor Laboratory Supervisor
	4. Correct field procedures.	Subcontractor Field Supervisor
	5. Check QC internally.	Subcontractor Laboratory Supervisor
	6. Maintain custody and tracking records.	B&V Project Document Control Officer
	7. Validate and check sample data coding.	B&V QA Coordinator
C.	Data Reporting	
	1. Prepare QA laboratory reports.	Subcontractor Laboratory Supervisor
	2. Prepare QA field reports.	Subcontractor Laboratory Supervisor
	3. Review/check QA laboratory and field reports.	B&V QA Coordinator
	4. Prepare QA reports to WDOE.	B&V QA Coordinator

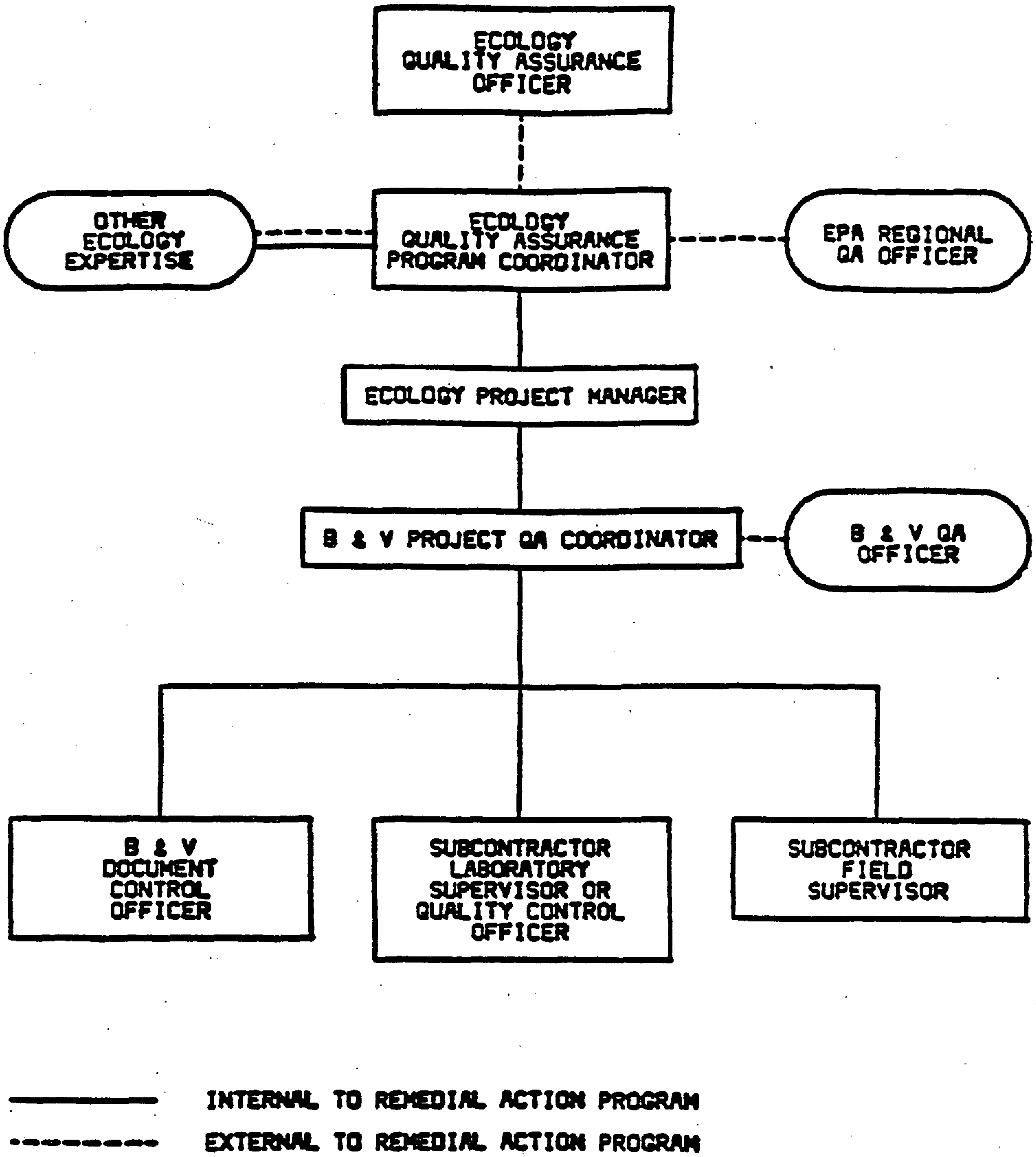

Figure 3-1 Project Organization for Midway Landfill

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 MEASUREMENT OBJECTIVES

Measurement parameters vary depending upon the circumstances surrounding a specific sampling event, the type and concentration of material, and the media to be sampled. All measurements will be made to yield consistent results that are representative of the media and conditions measured. All data will be reported in units consistent with those of other agencies and organizations to allow comparability of data bases.

To ensure the quality of data from field sampling, the following quality control samples will be submitted to the contract laboratory(s): rinsing, duplicate, known concentration, and blank samples. Rinsing samples will be collected in the field. The other three quality control samples will be provided by the EPA Region X laboratory and submitted to the contract laboratory(s) from the field. It is expected that the following recommendations may be revised when Ecology/EPA provides further guidance on field sampling precision requirements.

QA/QC requirements for analyses within the Contract Laboratory Program will be addressed internally by the contract laboratory performing the analyses.

4.2 RINSING SAMPLES

Daily samples will be collected of the solutions used to rinse sampling equipment and containers. The samples will be labeled so that the laboratory will not be able to identify the origin of the sample.

4.3 DUPLICATE SAMPLE ANALYSIS

One duplicate sample analysis will be run for every 20 samples, except those of lesser number that need certification. The results of the duplicate sample analyses will be used to determine the statistical variation between replicate results. These results should fall within the limits proposed in Table 4-1 as being attainable. If these results are not attained, the analysis should be repeated. Corrective actions to resolve unsatisfactory analytical quality control must be implemented immediately.

4.4 KNOWN CONCENTRATION ANALYSIS

One out of about every twenty samples will be spiked prior to analysis with the compounds of interest to determine the percent recoveries of the analytical method for the sample matrix. The percent recoveries for the compounds of interest will be recorded. Percent recovery information for the compounds of interest will be determined on representative waste samples at the beginning of the project and used to evaluate subseuqent percent recovery data during the course of the project. Results found to be in statistical variance with the percent recovery data will be investigated to determine the source of the problem, i.e., matrix interferences and corrective action will be taken prior to resuming the analysis.

Air monitoring tubes and badges will be spiked on a weekly basis to determine and update the desorption efficiency data used to correct perimeter and personnel monitoring results. Spiking of air monitoring tubes and badges will consist of adding a known concentration of the compounds of interest to the tube or badge and allowing the tube or badge to equilibrate overnight prior to analysis.

4.5 BLANK ANALYSIS

A minimum of one field blank sample will be analyzed for every twenty field samples. This sample will be used to determine whether all solvents, sampling equipment, fixatives, preservatives, and sampling containers are free of contamination. If the field blank analysis results in significant levels of contamination, it will be compared with the results of the laboratory method blank analysis. A significant level of contamination in both the field and method blanks would likely

Table 4-1 OBJECTIVES FOR MEASURING DATA

Variable	Matrix[d]	Units	Method Detection Limit	Accuracy	Precision	Completeness	Methodology	Reference	Maximum Holding Time[e]
Priority Pollutant Analyses									
Volatiles	Sediment Water	ug/kg[a] ug/l	10-20 1	c	±15% ±15%	85% 85%	Purge + Trap/ GC/MS	f	14 days
Pesticides	Sediment Water	ug/kg[a] ug/l	25 0.01-0.5	c c	c c	85% 85%	Extraction/ EC/GC	f	7 days/ 40 days
PCBs	Sediment Water	ug/kg[a] ug/l	5 0.2	c c	±15% ±15%	85% 85%	Extraction/ EC/GC	f	7 days/ 40 days
Neutrals	Sediment Water	ug/kg[a] ug/l	5 1	c c	±15% ±15%	85% 85%	Extraction/ GC/MS	f	7 days/ 40 days
Acids/bases	Sediment Water	ug/kg[a] ug/l	10 1-5	c c	±30% ±30%	85% 85%	Extraction/ GC/MS	f	7 days/ 40 days
Phenols/Hydro-carbons	Interstitial water	ug/l	<0.1	c	c	85%	Extraction/ GC/FID or GC/MS	g	28 days
Trace Metals									
Sb, Cr^{+3}, Cu, Pb, Ni, Ag, As, Tl, Zn, Se, plus Fe and Mn	Sediment Water	ug/kg[a] ug/l	100 1	5-10% 5-10%	±10% ±10%	85% 85%	Graphite or flame AA, ICP	EPA 1982	6 months
Se, Cd	Sediment Water	ug/kg[a] ug/l	20 0.2	10% 10%	±10% ±10%	85% 85%	Graphite AA	EPA 1982	6 months
Hg	Sediment Water	ug/kg[a] ug/l	10 0.05	10% 10%	±10% ±10%	85% 85%	Cold vapor AA	EPA 1982	28 days
Cr^{+6}	Sediment Water	ug/kg[a] ug/l	100 1	5-10% 5-10%	±10% ±10%	85% 85%	Graphite or flame AA, ICP	EPA 1982	48 hours 24 hours
Conventional Analyses									
Total organic carbon	Sediment	Percent[a]	0.01	±5%	±3%	85%	High temp combustion	EPA/COE 1981	28 days
Total sulfide	Sediment	mg/kg[a]	1	±10%	±10%	85%	Titrimetric: specification ion probe	Standard Methods 1985	24 hours
Total solids	Sediment	Percent[b]	0.05	--	±5%	85%	105° drying	EPA/COE 1981	7 days
Grain size	Sediment	Percent[a]	0.01	--	±5%	85%	Sieve and pipet analysis	Buchanan and Kain 1971	6 months
Oil and grease	Water	mg/l	10	--	±10%	85%	Freon extraction: gravimetric	EPA/COE 1981	28 days

[a]Dry weight basis.

[b]Net weight basis.

[c]Accuracy to be determined with appropriate reference standard if available: precision to be determined by replicate analyses performed during the study

[d]See Table 5-1 for type of containers and preservation.

[e]Samples should be anlyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if monitoring laboratory has data on file to show that the specific types of samples under study are stable for a longer time. Some samples may not be stable for the maximum time period given in the table. A monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
Where two times are given, the first refers to the maximum time prior to extraction, the second to the maximum time prior to instrumental analysis.

[f]There are no appropriate U.S. EPA approved methods for analysis of these organic compounds in sediments at the required detection limits. The methods used for this study are based upon MCTMO TPPS protocols and approved EPA methods. A more detailed summary of the method is provided in Section 10 (Analytical Procedures).

[g]This method is a protocol developed at the University of Washington. A more detailed summary of the method is provided in Section 10 (Analytical Procedures Detection limits are dependent on the volume of interstitial water analyzed.

indicate laboratory contamination. This situation will be addressed by the laboratory QA/QC officer. Significant field blank levels can be due to cross-contamination during sample preparation, sample leakage, or poorly sealed containers. This situation will be addressed by the onsite QA Manager.

4.6 NUMERICAL OBJECTIVES

Quality assurance objectives for precision, accuracy, and completeness have been proposed for each measurement parameter, where possible, and are presented in Table 4-1.

5.0 SAMPLING PROCEDURES

5.1 INTRODUCTION

The objective of the sampling procedures is to obtain samples that represent the environmental matrix being tested at the Midway Landfill site. Trace levels of contaminants from external sources will be eliminated through the use of proper sampling techniques and equipment. The sampling program for the remedial investigation of the Midway Landfill was developed by Black & Veatch, with the assistance of Hart-Crowser & Associates Inc. The detailed Sampling Plan is included in the Appendices and contains:

- o guidelines for sampling site selection.
- o specific sampling procedures.
- o type of samples.
- o sampling program operations.

Many samples, namely field gas samples, will be analyzed by instrument immediately at source. Thus, no actual sample will be returned. To substantiate results, samples will be taken on a predetermined schedule and sent to the laboratory for analysis. A "field gas sample log sheet" is included in the Appendices under Standard Forms to be Used.

5.2 CHANGES IN SAMPLING PROCEDURES

Even though the Sampling Plan was developed specifically for the Midway Landfill Remedial Investigation, actual sampling activities might require a change in the sampling procedures. For such an instance, Sampling Alteration Checklist is provided in the Appendices under "Standard Forms to be Used" to document changes in the sampling procedures. Prior approval from the Project Manager is needed to make changes.

5.3 SAMPLING SCHEDULE

The final sampling schedule will be established prior to start of field work. This schedule is really a function of the priority to be placed on the project and funding. The final Sampling Schedule has been developed and is included in the Final Sampling Plan included in Appendix B.

5.4 SAMPLE CONTAINER AND PRESERVATION

Containers for sampling are specified in Table 5-1 for each type of sample. The preservation method is also given for each type of sample.

5.5 DECONTAMINATION OF SAMPLING EQUIPMENT

All drilling equipment and materials shall be decontaminated prior to any drilling operations and between borings. All tools used for soil sampling, including Shelby tube and split-barrel samplers, will be decontaminated prior to the collection of each sample. Stainless steel trays and sample spoons will also be decontaminated prior to obtaining or homogenizing each soil sample. All sample spoons will be disposed after use on each discrete sample.

The decontamination setup procedure for the above equipment is as follows:

(1) A source of water under pressure is located or water is supplied by the team in reconditioned 55-gallon open-head drums and a small battery powered centrifugal or peristaltic pump is used for transfer.

(2) A galvanized wash tub is filled to a depth of about 6 inches (15 gallons) with potable water and an alconox and sodium carbonate solution is mixed.

(3) Supplies of 95 percent isopropyl alcohol and 1,1,1 trichloroethane (TCA) or acetone are placed in 1-quart Teflon squeeze bottles or garden sprayers and all solvents are labeled using duct tape strips.

(4) An empty galvanized tub is provided in the decontamination area to contain solvent rinsing.

Table 5-1. Sample Quantities, Containers, and Preservatives

ORGANICS

A. WATER

- Low Concentration

  One 1-gallon glass bottle, two 0.5-gallon glass or 4 1-liter glass bottles (Teflon-lined caps). Leave headspace. Ice to 4 C.

  Two 40-ml glass volatile organic analysis (VOA) vials (duplicates) (Teflon-lined caps). Leave no headspace. Ice to 4 C.

- Medium Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined caps). Fill 3/4 full. Do not ice. Note: Collect a 1- or 2-liter sample when total concentrations or fractions are suspected in the low range.

- High Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined cap). Fill half full. Do not ice.

B. SOILS OR SEDIMENTS

- Low Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined caps). Fill no more than 3/4 full. Ice to 4 C.

- Medium Concentration

  One 4-ounce glass wide-mouth bottle (Teflon-lined caps). Fill 3/4 full. Do not ice.

- High Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined caps). Fill half full. Do not ice.

Table 5-1. Sample Quantities, Bottles, and Preservatives (Continued)

INORGANICS

A. WATER

- Low Concentration (use Teflon-lined caps)

  One 1-liter high-density polyethylene bottle (for metals, add 1:1 HNO_3 preservative to adjust to pH 2)

  One 500-ml high-density polyethylene bottle (for NH_3, add 1:1, H_2SO_4 preservative to adjust to pH 2). Ice to 4 C.

  One 1-liter high-density polyethylene bottle (for CN^-, add 6N NaOH preservative to adjust to pH 12). Ice to 4 C.

  One 1-liter high-density polyethylene bottle (for $S^=$, 2 ml 2N zinc acetate/liter preservative). Ice to 4 C.

- Medium and High Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined caps). Fill half full. No ice or preservatives.

B. SOILS OR SEDIMENTS

- Low and Medium Concentrations

  One 4-ounce glass wide-mouth bottle (Teflon-lined caps). Fill 3/4 full. No ice or preservatives.

- High Concentration

  One 8-ounce glass wide-mouth bottle (Teflon-lined caps). Fill half full. No ice or preservatives.

Prior to sampling, the extraction device (spoon, auger, shovel, pick, etc.) is scrubbed visually clean with the soap solution and a stiff long bristle scrub brush. After the solution scrub, the device is rinsed with potable water. Generally, this rinsing will be allowed to percolate to the soil in the decontamination area. The device is then spray rinsed over the second tub with isopropyl alcohol. When the alcohol has dripped off, the device is sprayed with TCA or acetone over the second galvanized tub. After the TCA or acetone rinse, the devices are stacked over the top of the second tub, allowed to drain by gravity, and allowed to dry by air. Used solvents are containerized daily by the sampling team and placed in 30-gallon drums. The drums will be maintained in temporary onsite storage or manifested and shipped to an RCRA permitted facility at the discretion of the Ecology/EPA Region X.

Following this procedure, one sample of TCA or acetone rinsing should be collected at each site for every 20 samples to monitor field cross-contamination. These rinsing samples will be submitted to the Contract Laboratory for analysis. Detectable contaminants in field rinsing samples will invalidate sample data.

5.6 SAMPLE HANDLING AND DECONTAMINATION

The collected sample and its container represent one of the major avenues of personnel and environmental exposure. All precautions are taken to ensure that all the samples removed from the site are inside the sample container and that no residue remains on the outside of the container. A complete Health and Safety Plan has been developed and is included in Appendix I. The procedure for collecting samples is as follows:

The procedure for collecting samples will be as follows:

(1) <u>Identify and document sample collection point or points, depth increment of samples to be collected, and sampling devices to be used</u> (Sample Custody, Section 8.0). This information is provided in general in the survey study plan and in complete detail with rationale for selection in the site logbook kept by the team leader.

In general, sample aliquot numbers and sample locations are predicated on collecting not more than 0.2 ft^3 of the sample material in the stainless steel sample composite collection pan. The number of aliquots to go into a single sample obviously will vary from unconsolidated sediment pockets where as many as 25 scoops may be taken with a stainless steel spoon to a complete drive core in a boring or well.

(2) Complete logbook entries, sample tags, field record sheets with sample identification point, date, time, and name or initial of the team leader.

(3) Place tags on sample containers.

(4) Place a small plastic bag around outside of sample container and hold in place with rubber band so that sample spilled outside of container will not contact jar.

(5) Return the stainless steel composite sample pan to the decontamination area. Hold securely, stir, mix vigorously with a clean stainless steel spoon to achieve homogeneity by crushing clumps and mixing individual aliquots.

(6) Transfer sample incrementally from the composite pan to properly tagged and bagged sample containers for duplicates of the sample. For example, when a duplicate is prepared, the total material in the pan is stirred vigorously and a heaping tablespoonful is extracted by sweeping through the material with the spoon. After one heaping tablespoonful is placed in each jar for the duplicate, the remaining material is again stirred vigorously and the process repeated until the individual containers are 2/3 full. The sample lids are then screwed on tightly on the individual containers.

(7) Transport the sealed 8-ounce sample jar containers to the packaging table. The outer plastic bag and rubber band are removed by the sampler without touching the external surface of the jar any more than necessary and the tagged sample jar is then placed by the sampler in a clean plastic bag held open by the person packaging the samples for shipment.

(8) Place the contaminated plastic bags, rubber bands, and residual dirt from composite pan in heavy (5 millimeter in thickness) plastic bags for drumming and temporary onsite storage.

(9) Clean all composite pans and other sampling devices using procedures previously described prior to the beginning of the next sample collection effort. All spoons will be disposed by bagging, labeling, drumming, and temporary onsite storage.

5.7 PACKING OF SAMPLES

Samples generated must be packaged according to the level of contamination present in each sample. The EPA CLP guidance documents classify samples into low concentration, medium concentration, and high concentration. These guidelines for packing samples are given in the Appendix for reference.

5.8 ALTERNATE PACKING MATERIAL INSTRUCTIONS

When using foam packing material, place a double layer of packing material in bottom of ice cooler. Place paint cans inside plastic bag. (Paint cans should be wrapped at least twice with foam packing material.) Two or three more layers of foam packing should be placed on top of paint cans. If larger coolers are used, more layers will be necessary to prevent movement during shipment. Seal plastic bag with fiberglass tape. (DOUBLE CHECK PAINT CAN CLIPS FOR SECURE FIT.)

5.9 ICE COOLER LABELING

The outside of all ice coolers should be labeled with the following information:

- EPA Region X Label "(DO NOT TAMPER" and EPA Region X Address.)
- Environmental Laboratory Samples Label.
- "This Side Up" Labels (2).
- "Up" Arrows (4).
- "Cargo Aircraft Only" Label.
- "Flammable Solid" or "Flammable Liquid", N.O.S. Label.
- Address Label (for CLP laboratory.)

6.0 SAMPLE CUSTODY

Sample custody is a vital aspect of remedial investigation programs generating data that might be used as evidence in a court of law. The possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in enforcement proceedings. To achieve the required documentation, the following documents will be completed:

1. Sample Identification Tags--A Sample Identification Tag is required for each container used for a sample. Since a sample can require several containers for transport and analysis, several tags can be required to identify a sample. For example, a low concentration waste sample requiring extractable organics (2 each, 80-ounce amber bottles), VOA's (2 each, 40 ml vials), and metals (1 each, liter polyethylene bottle) will require five container tags.
2. Traffic Reports (Organic and Inorganic)--Each sample requires one traffic report for organic analysis and one traffic report for inorganic analysis. The above example would require one organic and one inorganic traffic report. Duplicates and blanks are also documented on traffic reports.
3. Chain of Custody Forms--At least one chain of custody form is required per cooler.
4. Custody Seals--One custody seal is required per bottle, and two custody seals are required per cooler, one on the latch side and one on the hinge side of the lid.

All appropriate forms are included in the Appendices under "Standard Forms to be Used."

6.1 FIELD SAMPLING OPERATIONS

The most important aspect of sample custody is thorough, accurate record keeping. All information pertinent to a field survey and/or sampling will be recorded in a logbook. This must be a bound book, with consecutively numbered pages that are about 21.6 by 27.9 cm (8-1/2 x 11 in.). Entries in the logbook must include at least the following:

- o Name and title of author, date and time of entry, and physical/environmental conditions during field activity.
- o Purpose of sampling activity.
- o Location of sampling activity.
- o Name and address of field contact.
- o Name and title of field crew.
- o Name and title of any site visitors.
- o Type of waste and sampled media (e.g., soil, sediment, ground water, etc.).
- o Sample collection method.
- o Number and volume of sample(s) taken.
- o Description of sampling point(s).
- o Date and time of collection.
- o Sample identification number(s).
- o Sample distribution (e.g., laboratory).
- o References for all maps and photographs of the sampling site(s).
- o Field observations.
- o Any field measurements made, such as pH.
- o All sample documentation, such as;
  - -- Bottle lot numbers.
  - -- Custody seal number.
  - -- Traffic report numbers.
  - -- Dates and method of sample shipments.
  - -- Chain of custody records.
- o All documentation for barrels generated, such as;
  - -- Contents and approximate volume.
  - -- Type and predicted level of contamination.
  - -- Custody seal numbers.
- o Summary of daily tasks (including costs) and documentation on any cost or scope of work changes required by field conditions.

A station identification form and a sample log will be completed for each station occupied and each sample taken.

6.2 CHAIN OF CUSTODY RECORD

To establish the documentation necessary to trace sample possession from the time of collection, a chain of custody record must be filled out and accompany every sample and every shipment of samples to the CLP laboratory. This record becomes especially important when the sample is to be introduced as evidence in a court litigation.

The record will contain the following minimum information:

- o EPA sample tag identification number.
- o SMO contract sample number.
- o Signature of collector.
- o Date and time of collection.
- o Place and address of collection.
- o Waste type and sample media.
- o Signatures of persons involved in the chain of possession.
- o Inclusive date of possession.
- o Traffic report numbers.
- o Custody seal numbers.

An example of a chain of custody form is given in the Appendices under "Standard Forms to be Used."

6.3 SAMPLE LABELS AND SEALS

Each sample must be properly labeled and sealed immediately after collection.

6.3.1 Sample Labels

Sample labels are necessary to prevent misidentification of samples. All sample labels and tags will be provided by EPA Region X. The label will include a minimum of the following information:

- o Name of collector.
- o Date and time of collection.
- o Place of collection.
- o EPA Region X sample number and SMO Contract number, which uniquely identifies the sample.

The sample number sequence will not indicate to the laboratory which samples are duplicates, replicates, or field blanks.

6.3.2 Custody Seals

Custody seals will be used to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory. EPA Region X will provide all custody seals. The seals will carry information as follows:

- o Project name and location.
- o Collector's name.
- o Date and time of sampling.
- o Sample number. (This number must be identical with the number on the sample label.)

The seal must be attached so that it is necessary to break it in order to open the sample container. Custody seals will also be affixed to drums of material stored temporarily onsite.

6.4 SHIPPING OF SAMPLES

Samples will be delivered to the laboratory for analysis as soon as practical after the number of samples and number of coolers are sufficient for a shipment (preferably the same day the sample was taken). The sample must be accompanied by the chain of custody record and by a sample analysis request sheet. Samples must be delivered to the CLP laboratory for receipt.

When a sample is shipped to the laboratory, it must be packaged in a proper shipping container to avoid leakage or breakage. Samples will be packaged in plastic rigid coolers that provide a tight vermiculite packing around sample containers. Samples that require refrigeration must be packed with reusable plastic packs or cans of frozen freezing gels. Detailed packing instructions are included in Section 5.0.

Broken chain of custody records or seals will invalidate the use of all data from a shipment.

A packing list fore each sample shipments is included in the Appendices under "Standard Forms to be Used."

6.5 SAMPLE ANALYSIS REQUEST SHEET

A sample analysis request sheet is intended to accompany the sample on delivery to the laboratory. The field portion of this form will be completed by the person collecting the sample and will include most of the pertinent information noted in the log book. The laboratory portion of the form is intended to be completed by laboratory personnel and to include:

- Name of person receiving the sample.
- Laboratory sample number.
- Date of sample receipt.
- Sample allocation.
- Analyses to be performed.

An example of a request for analysis form is given in the Appendices under "Standard Forms to be Used."

6.6 LABORATORY TRACKING

The sample custodian at each laboratory will fill out the chain of custody record upon receipt of the samples and note questions or observations concerning sample integrity. A sample of the tracking record that follows each sample through all stages of laboratory processing is given in the Appendices under "Standard Forms to be Used" and must be maintained by the sample custodian.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures and frequencies used for the calibration of equipment and instrumentation to be used during the investigation. A description of the calibration procedure (or reference to a standard operating procedure), the frequency of calibration, and the calibration standards to be used are included.

7.01 WATER LEVEL MEASUREMENTS IN WELLS

Steel surveyors tapes shall be calibrated using manufacturer supplied temperature correction if applicable for field conditions. Electric well sounders shall be calibrated against steel surveyors tape prior to each site use.

7.02 PH MEASUREMENT DURING WELL DEVELOPMENT PRIOR TO SAMPLING

Digital pH meter shall be calibrated using factory or laboratory supplied buffer solutions prior to and following each measurement. Temperature corrections shall be applied during measurement.

7.03 ELECTRICAL CONDUCTIVITY

Electrical conductivity meter shall be factory calibrated annually. Temperature correction shall be applied during measurement.

7.04 REDOX POTENTIAL

The meter used to measure the Redox Potential shall be factory calibrated annually. Temperature correction shall be applied during measurement.

7.05 WATER TEMPERATURE

Mercury thermometers shall be factory calibrated once.

7.06 FLOW RATES FOR WELLS DURING AQUIFER TESTS

Flowmeters shall be CALQFLO meter or equivalent. Calibration shall be done in factory and checked with timed volumetric measurement periodically during tests.

7.07 WATER LEVELS DURING SINGLE WELL AQUIFER TESTS

Pressure transducers shall be Envirolabs Model PT-105V or equivalent. They shall be semiannually calibrated at the factory and periodically calibrated in-house with water columns. Digital voltmeter shall be a digital multimeter and factory calibrated once.

7.08 PORTABLE GAS ANALYZERS

Various portable gas analyzers will be available for onsite use during field operations. These include:

Foxboro OVA128 Organic Vapor Analyzer (GC/FID).
HNu Organic Vapor Analyzer (PID).
MSA 361 Combustible Gas/Oxygen/H_2S Analyzer.
MSA 260 Combustible Gas/Oxygen Analyzer.
MSA 60 Combustible Gas Analyzer (% by Volume).
MSA Mini H_2S Analyzer.
Bacharach CO_2 Analyzer.
Bacharach TLV Analyzer.

Calibration procedures for each of these instruments are included in Appendix E, Equipment Calibration and Operation.

7.09 OTHER MISCELLANEOUS MEASURING DEVICES

Any other measuring device used will be documented and calibration procedures documented at the request of EPA or Ecology.

7.10 LABORATORY CALIBRATIONS

Procedures for calibration of laboratory equipment will conform with the CLP laboratory Quality Assurance Program Plan requirements.

8.0 ANALYTICAL PROCEDURES

Analytical measurements performed in the field will include pH, specific conductivity, redox potential, temperature, H_2S, oxygen, combustible gas level, and organic vapor analysis. In addition to these standard measurements, the project team will perform field screening of soil and water samples to select samples to be submitted to the Contract Laboratory Program (CLP). All other physical and chemical analyses will be performed according to EPA procedures by the EPA Contract Laboratory. CLP procedures are described in the Users Guide to the EPA contract Laboratory Program as prepared by the Sample Management Office, August 1982.

8.1 SPECIFIC CONDUCTIVITY, PH, AND REDOX POTENTIAL

The pH of all water samples will be determined onsite in accordance with EPA Method 150.1. Commercially available pH meters equipped with combination electrodes will be used for pH measurement. Calibration of the pH meter will be performed between measurements using at least two buffers that bracket the anticipated pH. Specific conductivity will be determined using a Wheatstone Bridge conductance meter in accordance with EPA Method 120.1. Redox potential will be measured with the same instrument.

8.2 FIELD SCREENING FOR VOLATILE ORGANICS

Selected samples will be screened for volatile organic compounds using an Organic Vapor Analyzer (OVA) and a headspace analysis technique. The OVA will be calibrated according to procedures found in Appendix E of this QA Project Plan. This field screening will provide real-time semiquantitative data on concentrations of volatile organic compounds present in wastes, waters, and soils and those present in gases from the landfill.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All raw data collected from project sampling tasks and used in project reports will be appropriately identified and will be included in a separate appendix of the report. Where test data have been reduced, the method of reduction will be described in the text.

9.1 FIELD DATA

The following reporting requirements will be followed for field data:

- Combustible gas level - will be reported as a percentage of LEL and shall be the arithmetic mean of three readings.
- Hydrogen Sulfide level - will be reported as ppm and shall be an arithmetic average of three readings.
- Oxygen level - will be reported as percent oxygen and shall be an arithmetic average of three readings.
- Organic vapor analysis - will be reported as ppm for each component selected for analysis.
- pH - field measurements will be reported to two decimal places.
- Electrical Conductivity - arithmetic mean of three readings will be used as reported value.
- Redox Potential - arithmetic mean of three readings shall be report to three places.
- Water Levels - the arithmetic mean of the measurements will be reported to the nearest 0.01 foot.
- Flow Rates - rates will be reported as single instantaneous readings or single determinations of flow rate integrated over time.
- Aquifer Test Data - drawdown and recovery data will be plotted in the field to determine anomalous or unexpected response. The data will be reported in millivolts.
- Sample Depths - tape measurements will be made to the nearest 0.1 foot; measurements made by known lengths of drill string will be made to the nearest 0.5 foot.

- Elevations of Sampling Sites -
  - -- new monitoring wells and unsurveyed existing wells will be surveyed to the nearest 0.01 foot.
  - -- approximate elevations of all other sampling sites will be determined to the nearest 0.1 foot.
- Locations of Soil/Water Sampling Sites - location accuracy will be 10 feet in general; monitoring wells will be located to the nearest 1.0 foot.

9.2 ANALYTICAL PROCEDURE REQUIREMENTS

All samples collected for the Remedial Investigation will be promptly packaged and delivered to designated laboratories. All laboratories for this study will be required to submit results that are supported by sufficient backup data and quality assurance results to enable reviewers to determine conclusively the quality of the data.

Sample analysis data from each laboratory will include the following information, where applicable, for data validation:

- Replicate results.
- Isotope standards recoveries.
- Spike recoveries (metals).
- Gas chromatograms and reconstructed ion current chromatograms.
- Procedural blank results.
- Field blank results.
- Mass spectra of target and tentatively identified compounds.
- Instrument tuning compound results.
- Detection limits.

Data processing quality control includes checking and verifying input data by manual comparison as well as by computer programs that perform compatibility checks and flag "outliers" for confirmation. It is anticipated that computerized plotting of data will be used as a tool for rapid identification of outliers.

10.0 QUALITY CONTROL CHECKS

Laboratory quality control checks for chemical data analyzed for this study are provided in the Contract Laboratory Program (CLP). Quality control checks on data supplied by the CLP laboratory will be performed using the QA/QC requirements outlined in Section 4.0. A confidence limit of 90 percent (10 percent error) will be used for all reported analytical laboratory values. If the confidence limit is violated, WDOE and EPA will be notified. If sample analyses must be performed a second time to verify data, the analyses will be performed at the direction of WDOE or EPA Region X.

10.1 DUPLICATE SAMPLES

As a minimum, one duplicate will be collected for every 20 field samples. Duplicates will be collected for all priority pollutant analyses.

10.2 BLANK AND KNOWN CONCENTRATION SAMPLES

The same format will be used for blank and known concentration samples as explained in Section 10.1, DUPLICATE SAMPLES.

10.3 RINSING SAMPLES

Rinsing samples will be collected for priority pollutant analyses. They will also be collected at a minimum frequency of one rinsing sample per 20 field samples as described in Section 5.5.

10.4 SAMPLE PRESERVATION BLANKS

As a minimum, one preservation blank will be collected for every 100 field samples or when a new bottle of preservative is opened. After a period of use, chemicals including acids used in the field can become contaminated. Known amount of preservatives should be added to distilled water and sent to the CLP laboratory for analysis.

10.5 SPLIT SAMPLES

Remove representative sub-samples from the collected sample to be analyzed by the same lab or by two different labs. Split samples can be arranged upon request at the direction of the Site Manager.

10.6 ANALYTICAL QC CHECKS

Analytical laboratories will demonstrate the ability to produce acceptable results using the modified methods recommended or their equivalent. The data will be evaluated based on the following criteria (as appropriate for inorganic or organic chemistry analyses):

- Performance on EPA method tests.
  - MS performance (DFTPP).
  - GC performance (tailing factors).
  - Blanks.
  - Precision of calibration and samples.
  - Linearity of response and linear range.
- Percent recovery of internal standards.
- Adequacy of detection limits obtained.
- Precision of replicate analyses.
- Comparison of the percentage of missing or undetected substances among replicate samples.

10.7 OTHER QUALITY CONTROL CHECKS

All water level measurements made with a steel tape will be made until an agreement to within 0.01 foot is obtained for at least two measurements.

Samples of all well construction materials will be retained for submission to the CLP laboratory for chemical analyses to determine contamination levels if required by questionable data. The samples will be classified as archive samples and will be bagged, labeled, and stored in the temporary onsite storage facility.

11.0 PERFORMANCE AND SYSTEM AUDITS

11.1 GENERAL

Performance and system audits for sampling and analysis operations consist of onsite reviews of field and laboratory quality assurance systems and equipment for sampling, calibration, and measurement. Environmental monitoring equipment will be serviced periodically and calibrated during field use.

Some analytical laboratories are required to take part in a series of performance and systems audits conducted by the National Enforcement Investigations Center (NEIC). For laboratories not involved in these audits, the Environmental Monitoring Systems/Support Laboratories provides the necessary audit materials, devices, and technical assistance. These laboratories also conduct scheduled interlaboratory performance tests and provide guidance and assistance in the conduct of system audits.

The Project Quality Assurance Coordinator (QAC), in conjunction with the Ecology, will develop and conduct external system audits based on the approved project plan. Performance audits will be conducted soon after the measurement system begins generating data. They will be repeated periodically as required by task needs, durations, and costs.

The Project QAC ensures that each QA Officer for each aspect of the project has performed adequate internal audits of performance and systems before submitting quality assurance reports to the management (see Section 15.0). The QA officers are listed in Section 3. The systems audit checklist (given in the Appendices under "Standard Forms to be Used") will be completed by the Project QAC when auditing each aspect of the project. Specific audit procedures are described below.

11.2 AUDIT PROCEDURES

11.2.1 Field Activities

The QAO may schedule audits of field activities at various times to evaluate the execution of sample identification, sample control, chain of custody procedures, field documentation, and sampling operations. The evaluation is based on the extent to which the applicable standard operating procedures (SOPs) are being followed.

The person conducting the audit is normally a senior technical reviewer who is familiar with the technical and procedural requirements of field sampling and with the applicable SOPs. The auditor keeps a record of his evaluation using field notes and checklists. Immediately following the audit, he reviews preliminary results with the person in charge of the sampling. The auditor also prepares an audit report containing the results of his evaluation and recommendations for any necessary corrective actions.

Audits are scheduled with the Project Manager and the person in charge of field sampling.

11.2.1.1 <u>Sample Identification Tags</u>. The auditor examines a selected number of sample identification tags for completeness and accuracy. He determines if the station number and location are correctly identified; the date and time collected are indicated; the type of sample and analysis are specified; the preservative, if used, is identified; and the samplers' signatures appear on the tag. The tag numbers will be checked to ensure that they are the ones issued to the project. The auditor also determines if the station location accurately identifies where the sample was actually taken and if the sampling methods used were as directed by the Project Manager.

11.2.1.2 <u>Chain of Custody Records</u>. The auditor selects a predetermined number of the chain of custody records to be audited in the field. The records must be reviewed to determine if the station number, station description, date, and time correspond to the sample identification tag; if the parameters to be analyzed have been appropriately identified; and if all custody transfers have been documented and the date and time of transfer recorded.

The auditor also determines if samples are properly maintained in custody at all times, e.g., locked up to prevent tampering.

11.2.1.3 Receipt for Samples Form. The auditor checks to make sure that a receipt for samples form is given to the owner, operator, or agent in charge of a facility or site whenever splits are provided for them, even if the offer for the receipt for split samples is declined. The auditors also check to make sure that the forms are properly completed and that signatures are obtained. If signatures are not obtained, the auditor checks the "Remarks" section of the chain of custody record for the transaction to see if a signature was requested and declined.

11.2.1.4 Traffic Reports. Organic and inorganic traffic reports prepared by the field investigation team for samples shipped to contractor laboratories also are subject to audit. The auditor ensures that the information recorded on the forms is correct and that it coincides with the information on the sample identification tags and on the chain of custody record.

11.2.1.5 Field Notebooks. Field notebooks are reviewed during the field investigation audit to see that each notebook is signed and all entries are dated. During field investigations, notebooks are either in the possession of individuals or are kept at each sampling station or location. The project number, EPA site number, date of receipt, and the name of the person receiving the book are recorded on the cover. For notebooks kept at each station, the project number and station number are recorded on the cover and on each page. All in situ measurements and field observations are recorded in the notebooks with all pertinent information necessary to explain and reconstruct sampling operations. Each page is dated and signed by all individuals making entries on that page. The Project Manager and the field team leader are responsible for ensuring that notebooks are present during all monitoring activities and are stored safely to avoid possible tampering. Any lost, damaged, or voided notebooks are reported to the Project Manager.

Notebook entries must be legible, written in ink, and contain accurate and inclusive documentation of project activities. Notebooks must contain only facts and observations since they form the basis for reports to be written later. Language should be objective, factual, and free of personal feelings or other terminology that might prove inappropriate. Entries made by individuals other than the person to whom the notebook was assigned must be dated and signed by the individual making the entry.

Photographs taken for evidential purposes must also be controlled. The auditor reviews the field notebook to determine if the photographs are properly documented. When movies, slides, or photographs are taken showing sampling sites or providing other documentation, they are numbered to correspond to the notebook entries. The name of the photographer, date, time, site location, and site description are entered sequentially in the notebook as photos are taken.

The Project Manager's logbook must document the transfer of notebooks to the individuals who have been designated to perform specific tasks for the field investigation. All pertinent information should be recorded in these logbooks from the time each individual is assigned to the project until the project is completed.

The auditor will review Field Notebooks for their adherence to these procedures.

11.2.1.6 Sampling Operations. The auditor reviews sampling operations to determine if they are performed as stated in the project plan or as directed by the Project Manager. The proper number of samples should be collected at the assigned locations. The auditor checks to determine that the samples are in proper containers and are properly preserved. He also determines if the required field measurements and quality assurance checks are being performed and documented as directed.

11.2.2 Document Control

The document control audit consists of checking each document submitted for accountability. All documents used for field investigations are checked against the list of field documents issued to the Project Manager or his designated person. Written explanations must be present for any documents unaccounted for. Documents other than those issued are reviewed to ensure that they all appear on an inventory and that all documents listed on the inventory are accounted for. The auditor checks the documents for an appropriate numbering system.

The documents are examined to determine that all necessary items, such as, signatures, dates, and project codes, are included.

The auditor examines any classified documents and determines if they are handled and stored in the proper manner.

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance of equipment is essential if project resources are to be used in a cost effective manner. Preventive maintenance will take two forms: (1) a schedule of preventive maintenance activities to minimize downtime and ensure accuracy of measurement systems and (2) availability of critical spare parts, backup systems and equipment. A preventive maintenance program for the following items to be used onsite will be implemented:

- o Measuring devices, steel tapes, rulers, and thermometers.
- o Pressure transducers, voltmeters, and voltage regulators.
- o pH, electrical conductivity, and redox potential meters.
- o Hydrogen sulfide, oxygen, combustible gas, and OVA instruments.
- o Split-barrel samplers.

It is anticipated that the following services will be subcontracted during the study:

- o Geophysical measurements
- o Personal protection and decontamination services.
- o Drilling and installation of monitoring wells.

Contract agreements with firms providing these services will specify that any and all equipment used at the site will be maintained in safe working order. Any equipment or device determined not to be in safe working order by Black & Veatch field personnel or the Site Safety Officer will be replaced, repaired, or corrected at the subcontractor's expense.

13.0 SPECIFIC PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The routine procedures for field measurements, hydraulic data, and chemical analysis that will be used to assess the precision, accuracy, and completeness of data collected on the project are described in the following sections.

13.1 FIELD DATA

Procedures for field measurements include:

- Measurement of pH - Readings will be taken in buffer solutions of the appropriate range at the same temperature as the sample before and after the measurement made on the sample.
- Measurement of electrical conductivity - Replicate measurements of electrical conductivity will be made. Standard solutions of known conductivity will be made available for checking precision. Several readings are taken and the arithmetic mean used as the reported value.
- Measurement of redox potential - Replicate measurements of redox potential will be made. These will be made at least once for every ten samples. Standard solutions of known redox or reoxidation potential will be made. Standard solutions of known redox value will be made available for checking precision. All checks are recorded to prove accuracy of measurements. Several reading (at least three) are taken and the arithmetic mean reported as the value.
- Measurement of combustible gas level - Three readings will be taken as a minimum and the arithmetic mean reported as the value. Replicate measurements will be made at least once for every ten samples. All checks are recorded to prove accuracy of measurements. Instrumentation will be available to determine gas concentrations in: 1) percent of the lower explosive limit (LEL) and 2) percent combustible gas by volume (MSA 361 or 260).

- Measurement of hydrogen sulfide - Three readings will be taken as a minimum and the arithmetic mean reported as the value. Replicate analysis will be made at least once for every ten samples. All checks are recorded to prove accuracy of measurement. Instrumentation will be available to read 0-50 ppm (MSA 361) or 0-200 ppm (Handheld MSA indicator), with minimum detection limits of 1 ppm.
- Measurement of oxygen - Three readings will be taken as a minimum and the arithmetric mean reported as the value. Replicate analysis will be made at least one for every ten samples. All checks are recorded to prove accuracy of measurement. Instrumentation will be available to read 0-25 percent by volume (MSA 361 or 260).
- Measurement of organic vapor composition - Replicate analysis will be made at least once for every twenty samples. Duplicate samples will be taken and submitted to the laboratory for analysis. All checks are recorded to prove accuracy of measurement. Instrumentation will be available to read 0-2,000 ppm organics (HNu) or 0.1-1,000 ppm organics (OVA 128).

13.2 HYDRAULIC DATA

- Measurement of water level with steel tape - Water levels made with steel tape are measured at least three times until readings agree to 0.01 foot under static water level (non-pumping) conditions. The arithmetic mean of the measurements is taken and recorded to the nearest 0.01 foot, excluding any others.
- Measurement of water level with electronic equipment - Water levels with an electric sounding device are taken at least twice and the arithmetic mean reported.
- Measurement of flow rates during pumping - Because flow rates can change, single instantaneous readings on a flowmeter or

single determinations of flow rate integrated over time are made.

- Aquifer test data - Field plotting of water level or pressure changes is performed to determine anomalous or unexpected response. Such response may indicate drift or changing calibration of the measuring system. Such plotting is also done to determine when data is sufficiently complete to terminate the test.

13.3 CHEMICAL ANALYSIS

Routine procedures to be used to measure precision and accuracy include:

- Replicate analysis -
  - Volatiles; trace metals; and acid, base, and neutral organic compounds. Duplicate every 20 samples. If less than 20 samples are obtained during a sampling event, provide one duplicate per event. (Insufficient sample will be available for replication of interstitial water analyses.)
  - Ancillary parameters. Minimum of 10 percent of the samples analyzed.
- Matrix spike -
  - Trace metals; volatiles; and acid, base, and neutral organic compounds. Spike every 20 samples. If less than 20 samples are obtained during a sampling event, provide one duplicate per event. (Organic analyses conducted with recovery standards spiked in each sample will not require additional spiked samples for QA.)
- Procedural blank -
  - Trace metals; volatiles; and acid, base, and neutral organic compounds. Each set of samples processed.

Completeness will be measured for each set of data received by dividing the number of valid measurements actually obtained by the number of valid measurements that were planned, as specified in the sampling plan.

14.0 CORRECTIVE ACTIONS

The procedures to be implemented (when audits or data analysis indicate the project has deviated from procedural requirements) are described below.

When any of the checks given in Section 13.0 for field measurements, other than those for the gas chromatograph (GC), indicate instrumentation or measurement error, the following corrective actions will be taken:

- o Repeat the measurement to check the error.
- o Check for all proper adjustments for ambient conditions such as temperature.
- o Check the calibration.
- o Replace the instrument or measurement devices.

When instrumentation or measurement error are indicated while operating the GC, the following corrective action procedures will be followed:

- o Reanalyze.
- o Check calibration.
- o Run blanks.
- o Check for contaminated syringes/plumbing.
- o Recalculate data.

The QA officers are responsible for their respective areas of involvement. Predetermined methodology, limits of acceptability, and required sample handling are listed in Tables 4-1 and 5-1. Corrective action required to conform to the specifications will be recorded by the QA officer and reported to the Project QAC within 3 days. Corrective actions will be documented using the Corrective Action Checklist given in the Appendices in the section "Standard Forms to be Used" and included in the QA/QC report to the management.

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reports will be compiled periodically over the course of the project. QA reporting will be tied to the completion of various elements of the work rather than to general time periods. QA reports will be submitted by the Project QAC to management within 7 days following the completion of defined task elements.

The QA sampling reports from the Project QAC will contain copies of the following information, where appropriate:

- Field log.
- Station log (from marine sampling).
- Sample log.
- Chain of custody forms.
- Packing lists.
- Corrective action checklist.
- Systems audit checklist.
- Sampling alteration checklist.

The completed forms will be accompanied by a technical memo from the Project QAC summarizing the reports and noting significant quality assurance problems that arose during the reporting period.

Data along with the appropriate quality control information will be reported separately when the information is received. The handling and contents of the data reports are discussed in Section 9.0, Data Reduction.

16.0 REFERENCES

American Public Health Association, "Standard Methods for Examination of Water and Wastewater," 16th Edition, Washington D.C., 1985, p. 1268.

Black & Veatch, Final Sampling and Analysis Plan, Midway Landfill, Kent, Washington, September 5, 1985.

Black & Veatch, "Forward Planning Document for Midway Landfill," Kent, Washington, WDOE Contract No. C-85075, March 7, 1985.

Black & Veatch, "Project Work Plan for Remedial Investigation - Planning Activities Midway Landfill Site," Kent, Washington, May 3, 1985.

Black & Veatch, "Sampling Plan for Installation of Gas Probes near Midway Landfill," Kent, Washington, August 30, 1985.

METRO, "Analytical Support and Data Validity: Organics," Technical Documentation for the Toxicant Pretreatment Planning Study, 1981, Revised 1983, p. 250.

Municipal Environmental Research Laboratory, "Samplers and Sampling Procedures for Hazardous Waste Streams," EPA-600.280-018, U.S. EPA, Cincinnati, Ohio, 1980.

U.S. Environmental Protection Agency and Army Corps of Engineers, "Procedures for Handling and Chemical Analysis of Sediment and Water Samples," Technical Report EPA/COE-81-1, U.S. Army Waterways Experiment Station, Vicksburg, MS, 1981, p. 471.

U.S. Environmental Protection Agency, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, OH, 1979.

U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," SW-846, 2nd edition, 1982.

U.S. Environmental Protection Agency, "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act," U.S. EPA, Washington, D.C., Federal Register, Vol. 49, No. 209, 1984, pp. 43234-43436.

17.0 APPENDICES

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17.01 APPENDIX A

GLOSSARY OF TERMS

17.01 APPENDIX A

17.01.01 Audit

A systematic check to determine the quality of operation of some function or activity. Audits may be of two basic types: 1. performance audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system, or 2. system audits of a qualitative nature that consists of an onsite review of a laboratory's quality assurance system and physical facilities for sampling, calibration, and measurement.

17.01.02 Data Quality

The totality of features and characteristics of data that bears on their ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

17.01.02.1 Accuracy. The degree of agreement of a measurement (or an average of measurements of the same thing), X, with accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

17.01.02.2 Precision. A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."

17.01.02.3 Completeness. A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected under correct, normal conditions.

17.01.02.4 Representativeness. Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

17.01.02.5 <u>Comparability</u>. Expresses the confidence with which one data set can be compared to another.

17.01.03 <u>Data Validation</u>

A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification, and review.

17.01.04 <u>Environmentally Related Measurements</u>

A term to describe essentially all field and laboratory investigations that generate data involving: 1. the measurement of chemical, physical, or biological parameters in the environment; 2. the determination of the presence or absence of criteria or priority pollutants in waste streams; 3. assessment of health and ecological effect studies; 4. conduct of clinical and epidemiological investigations; 5. performance of engineering and process evaluations; 6. study of laboratory simulation of environmental events; and 7. study or measurement of pollutant transport and fate, including diffusion models.

17.01.05 <u>Performance Audits</u>

Procedures to determine quantitatively the accuracy of the total measurement system or component parts thereof.

17.01.06 <u>Quality Assurance</u>

The total integrated program for assuring the reliability of monitoring and measurement data. A system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

17.01.07 <u>Quality Assurance Program Plan</u>

An orderly assembly of detailed and specific procedures that delineates how data of known and accepted quality data are produced for a specific project. A given agency or laboratory would have only one quality assurance plan.

17.01.08 Quality Assurance Project Plan (QAPP)

A detailed plan of samples to be obtained and analysis to be performed to quantitatively identify the environmental hazard of a specific site. Each site has its own plan.

17.01.09 Quality Control

The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

17.01.10 Standard Operating Procedures (SOP)

A written document that details an operation, analysis, or action whose mechanisms are thoroughly prescribed and that is commonly accepted as the method for performing certain routine or repetitive tasks.

17.02 APPENDIX B

REMEDIAL INVESTIGATION

SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
for
MIDWAY LANDFILL
KENT, WASHINGTON

APRIL 2, 1986

State of Washington
Department of Ecology
Office of
Hazardous Substances and Air Quality Control

Black & Veatch
Engineers-Architects

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1.0 INTRODUCTION

This sampling plan has been developed for the Midway Landfill, located in the City of Kent, Washington, as part of the remedial investigation and feasibility study being conducted for the site. The sampling program developed for the site is designed to provide the data necessary to formulate and evaluate alternative remedial actions and to develop the conceptual design(s) of the preferred remedial action for final site remediation, consistent with State (including Chapter 70.105A RCW), Federal (including CERCLA, RCRA, TSCA), and local policies and guidelines designed to protect human health and the environment.

1.1 SITE LOCATION AND DESCRIPTION

The Midway Landfill is a privately owned landfill that was operated by the City of Seattle Solid Waste Utility from 1966 to 1983. The site consists of approximately 60 acres, located at South 248th and Pacific Highway South, inside the City of Kent, and is approximately 16 miles south of Seattle. The site is bordered on the east by Interstate 5. The site was formerly the location of a gravel mining operation and a peat bog lake, Lake Mead. The regional setting and site boundaries are shown on Figure 1.

Although the facility was to be operated only as a non-putrescible landfill accepting demolition and transfer station wastes, it has been reported that unknown quantities of solvents, organic and inorganic chemicals, heavy metals, and contaminated dredge materials have been placed at Midway.

The presence of methane and other gases generated during the decomposition process of the landfill materials presents potential threats to human health and the environment at the site. Additionally, there is concern over the possible presence of organic vapors from solvents and other organic compounds allegedly disposed in the landfill.

The groundwater analysis performed on the site monitoring wells indicated the presence of heavy metals and organics contamination. The presence of methane gas in the landfill and migration of the gas off the property has also caused concern over safety issues for surrounding residences and businesses.

Currently, the Seattle Engineering Department is investigating options for closure of the site under State of Washington solid waste guidelines. As part of this effort, geotechnical and hydrological investigations were performed and alternatives for closure of the site have been developed. The Seattle Engineering Department has completed a series of field investigations at the landfill site since 1982, including a system of methane flares and standpipes throughout the facility, shallow and deep gas probe clusters for gas monitoring, and groundwater monitoring wells. Most recently, the City has directed the implementation of a gas control system which consists of a curtain of gas extraction wells around the perimeter of the site , a gas collection system of piping and headers, and temporary blowers and flares to burn the gas. The City is currently completing the system and will construct a single permenent blower and flare system to serve the gas collection system.

Recently, the Department of Ecology and the City of Seattle have installed offsite gas extraction wells to remove gas which has migrated offsite to the east and northwest of the landfill.

1.2 SCOPE OF FIELD ACTIVITIES

The field activities for the Remedial Investigation of Midway Landfill are described in this sampling plan. The scope of the field activities was developed based on an evaluation of existing information, identification of data gaps and the extent of data gaps, and the identification of the types and extent of data needed to formulate remedial action alternativies. Background information relating to the site and the results of previous sampling and monitoring efforts may be found in the "Forward Planning Document for Midway Landfill", dated March 7, 1985, prepared by Black & Veatch for the State of Washington, Department of Ecology.

Recent field investigations and evaluation efforts related to the gas migration problem have resulted in an accelerated schedule for additional RI activities with regard to gas related problems. This RI Sampling and Analysis Plan has been revised to complement ongoing gas related investigations conducted under other work assignments.

The following sections present a summary of the remedial investigation objectives, a brief description of data currently available, and a description of the field activities designed to obtain the data needed to meet the remedial investigation objectives. Included is a summary of the types of samples to be obtained, the numbers and locations of samples, sampling methods, and laboratory analyses. The Quality Assurance Project Plan, which describes sample handling, analytical chemistry, sample chain-of-custody, and other QA/QC procedures, is provided as a separate document, as is the Site Health and Safety Plan.

2.0 REMEDIAL INVESTIGATION FIELD ACTIVITIES

The purpose of the field activities phase of the remedial investigation for Midway Landfill is to obtain sufficient data to identify the magnitude and the extent of contaminant and gas migration and to assess remedial action alternatives during the feasibility study. The collection and review of all data developed during the investigation will be done in a legally defensible manner, in accordance with CERCLA guidelines.

The investigation will consist of activities to be conducted in four major areas: geologic investigations; hydrologic investigations including groundwater, surface water, and leachate; a gas emission/air quality investigation; and an investigation to identify receptors including initial endangerment assessment activities. In general, the technical objectives of the investigation include the following:

- Define subsurface stratigraphy and geohydrology at the Midway Landfill site.

- Define the nature and extent of water, air, and soils contamination at the Midway Landfill site to support a subsequent remedial action feasibility study.

- Define the nature and extent of landfill gas subsurface migration adjacent to the Midway Landfill site in support of current Initial Remedial Measures (IRM'S) and ongoing gas investigations.

- Determine the effectiveness of the gas control system implemented at the Midway Landfill site by the City of Seattle.

- Expand on the existing technical data base to determine adequacy of the proposed City of Seattle final closure plan for Midway Landfill.

- Further identify potential offsite contamination receptors adjacent to the Midway Landfill site.

2.1 GEOLOGIC INVESTIGATION

2.1.1 Subsurface Stratigraphy

2.1.1.1 Objectives

Definition of the subsurface stratigraphy at the Midway Landfill is critical in understanding the occurrence and movement of landfill contamination (landfill gas and leachate) at the site. Representative geologic samples collected from boreholes completed in and around the landfill (during installation of gas probes, leachate wells, or groundwater monitoring wells) provide the basis for identifying stratigraphic units and delineating the extent of these units over the site and contiguous areas. Geologic logs of boreholes are used to construct geologic cross sections of the site that depict subsurface conditions and describe key stratigraphic units.

2.1.1.2 Evaluation of Existing Data

The draft "Environmental Impact Statement for Closure-Midway Landfill", City of Seattle, 1985 includes cross sections through the landfill that utilize existing monitoring wells as control points. These cross sections delineate landfill materials and glacial strata beneath the fill area and adjacent properties, down to an elevation of about 225 feet above mean sea level. Stratigraphic identification and delineation of contacts between strata are estimated over much of the site, however, mainly due to the limited quality of geologic samples provided by the air rotary drilling technique that was utilized in installation of many of the monitoring wells and gas probes. The thickness and extent of the glacial units underlying the landfill and surrounding area need to be determined more accurately, especially the finer-grained strata (silts and clays) which appear to influence groundwater occurrence and movement. Subsurface conditions should also be defined beyond the boundaries of the landfill by utilizing geologic information from offsite monitoring wells, gas probe boreholes, and water supply wells.

2.1.1.3 Sample Collection and Analysis Rationale

Additional subsurface information will be obtained from new monitoring wells, leachate wells, and landfill gas probes to be installed in and around the landfill. Cable tool and hollow stem auger drilling methods will be employed to obtain representative geologic samples at regular depth intervals using standard ASTM split spoon methods. These new geologic data will be interpreted in conjunction with existing test boring information to further define subsurface conditions in the vicinity of the site. Details regarding locations, depths, and installation methods for new landfill gas probes and monitoring wells are described in subsequent sections of this sampling plan.

2.1.2 Soils Investigation

2.1.2.1 Objectives

The objective of soils investigations at the Midway Landfill site is determination of any soils contamination which has occurred due to past disposal practices at the site and any new soils contamination which may be occurring due to migration of contaminants offsite.

2.1.2.2 Existing Data

Near surface soils comprise the upper six feet of the study area. Records of boreholes indicate that there is no site cap on the landfill site itself, and that the fill generally consists of a dark gray to black mixture of decomposed paper, plastic, steel, wood, and some soil used for fill material or daily cover. Boreholes in the perimeter of the landfill show near surface soils consisting of brownish gray fine to coarse sands. The characteristics of "Terminal 5" sediments which were deposited at the site in recent years has been determined, and those materials do not appear to be dangerous wastes with respect to State of Washington dangerous waste criteria. Those sediments are currently stored on the surface of the landfill on an approximately one acre site, and apparently will be graded and covered as a part of the overall closure plan for the site prepared by the City of Seattle. The closure plan for the site will include final grading of the site, filling of the remaining pond areas at the site which currently create an infiltration problem into the fill material, and a final soil cap of relatively impermeable uncontaminated soil to retard infiltration.

2.1.2.3 Sample Collection and Analysis Rationale

No further sampling or analysis of existing onsite soils or the "Terminal 5" sediments will be completed as a part of the remedial investigation. Adequate data exists to define the quality of these geologic materials and the site closure plan will totally cover these materials with a cap of uncontaminated relatively impermeable soil.

soils have not been characterized to date with respect to contaminant migration from the Midway Landfill site. Soil contamination could occur locally due to leachate seeps originating from within the subsurface strata of the landfill material or from contaminated surface runoff. Therefore, soils samples from approximately 20 seep locations around the perimeter of the landfill will be obtained to characterize any potential soils contamination caused by leachate or surface water runoff. These samples will be obtained using a shallow soils coring device at the 0-2 foot depth in the immediate area of seeps which are discovered during the remedial investigation. Several soil cores from the immediate area of the seep will be composited to prepare a single homogenous soil sample for laboratory analysis. Each sample will be extracted in the laboratory and analyzed for those parameters listed in Table 6.

2.2 HYDROGEOLOGIC INVESTIGATION

2.2.1 Leachate Characterization

2.2.1.1 Objectives

The objectives of leachate characterization are (1) to determine the chemical characteristics of leachate by sampling of monitor wells and subsequent laboratory analysis, (2) to determine the distribution of leachate within and adjacent to the fill material, and (3) to determine hydrogeologic characteristics of the leachate for purposes of evaluating the potential for a future leachate withdrawal and treatment program.

Leachate samples are useful in landfill investigations to evaluate the chemical composition of the leachate as a source of groundwater contamination. Definition of key indicator parameters in leachate from a particular landfill can provide a means of tracking groundwater contamination away from the landfill. The distribution of leachate, as indicated by moisture content of geologic fill samples and leachate fluid level measurements, is important in evaluating the geometry of the leachate saturated zone and the potential for horizontal and vertical leachate migration. The ability to influence the distribution of leachate, as determined by pump tests and well drawdown tests, is important in evaluating the feasibility of leachate treatment or other appropriate remedial actions.

2.2.1.2 <u>Evaluation of Existing Data</u>

The draft "Environmental Impact Statement for Closure-Midway Landfill", (City of Seattle, 1985) presents fluid levels and chemical data from two wells completed in the landfill material. Fluid levels indicate that water is collecting in a perched condition above the local water table. Chemical data from leachate analysis shows elevated concentrations of typical leachate parameters (total dissolved solids, ammonia nitrogen, and iron). Although these data are useful, additional leachate wells installed in other parts of the landfill are needed to define fluid levels and leachate quality across the site.

2.2.1.3 <u>Sample Collection and Analysis Rationale</u>

A total of three additional leachate monitor wells will be installed within the Midway Landfill at the approximate locations shown on Figure 3. Borings will be completed using the hollow stem auger drilling method unless anticipated total depths of the borings are such that a different method is required. Final decision on boring location and drilling method will be made during detailed site planning activities. The anticipated depths and screened intervals of the leachate monitor wells are shown in Table 1. Each borehole will be drilled to a depth below the bottom of the fill sufficient to characterize till and advance outwash deposits. Geologic samples will be collected from the fill and the strata below the fill at 5-foot intervals. The zone below the fill will be backfilled with bentonite slurry grout through the hollow stem auger to prevent downward migration of leachate below the fill material. Subsequently, well development tests to determine landfill permeability will be performed. Test methods will be the same as those utilized on groundwater monitor wells. Also, fill samples will be tested for moisture content to determine the zone of saturation within the fill at the drilling locations.

One of the leachate monitor wells will be installed with a minimum 4-inch ID steel casing to allow higher flow rate pump testing for drawdown tests. Drawdown tests may be performed using the larger diameter leachate well to determine the area of influence of the well for leachate withdrawal as part of a future leachate withdrawal and treatment feasibility study. Additional leachate monitor wells or, if appropriate, onsite City of Seattle gas extraction wells will be used in conjunction with the withdrawal well to determine leachate drawdown characteristics. Decisions regarding the exact location of and specifications for the larger diameter leachate well will be made during detailed site planning activities. Drawdown tests will be conducted at a future date when all necessary facilities are in place and operational.

Leachate monitor wells will be sampled using the same methods and analyzed for the same parameters described in the groundwater monitoring section of this sampling plan (see Table 3).

2.2.2 Groundwater Hydrology and Characterization

2.2.2.1 Objectives

The major objectives of the groundwater portion of the hydrogeologic investigation are to determine the extent and migration rate of groundwater contamination at the Midway Landfill. This determination requires an understanding of the occurrence, movement, and quality of groundwater in the earth materials beneath and adjacent to the landfill. Properly constructed and located monitor wells provide geologic, water level, and water quality data. These data allow determination of horizontal groundwater flow directions, vertical groundwater gradients, groundwater migration rates, and groundwater quality, and enable the impacts of the landfill on the groundwater system to be evaluated.

2.2.2.2 Evaluation of Existing Data

The existing monitor well network on and adjacent to the landfill is shown in Figure 2. As noted in the Geologic Investigation section of this sampling plan, the existing data do not allow sufficient delineation of geologic units that may influence groundwater occurrence and movement in the vicinity of the landfill (sand/gravel versus silt/clay). In addition, the existing monitor well network does not allow adequate determination of groundwater flow directions in the water table aquifer, vertical groundwater gradients from the water table to deeper hydrogeologic units, or the extent of groundwater contamination from leachate generated by landfill. Records of water wells in the area have been utilized to compile a generalized regional groundwater flow map, and a water well inventory for the immediate vicinity of the landfill has been compiled by the City of Seattle. A water well inventory can provide useful offsite geologic information, and is also necessary to determine the potential impacts of ground water contamination on local water supply systems.

2.2.2.3 Sample Collection and Analysis Rationale

A. Water Well Inventory

An inventory of water wells within 1 mile of the landfill boundary will be compiled. The initial inventory will consist of tabulating water well records on file at Ecology and at the City of Seattle Engineering Department. Local municiplaities and utilities will be contacted as necessary to determine the buildings within 1 mile of the landfill that are served by a public or private water supply system.

Private wells no longer used for water supply may be accessible for water level and or water quality measurements. If necessary, contacts with individual land owners will be made to confirm locations of private wells. These efforts will be coordinated with the community relations officer for the project.

Locations of public supply, industrial, domestic, and other water wells will be plotted on a map, and the records of these wells will be compiled. The service areas of water utilities will also be delineated on this map. The map and associated well logs will be utilized to select offsite wells for possible water level measurements and sampling, and to assess the susceptibility of water supply wells to contamination by groundwater migrating offsite from the landfill.

B. Groundwater Monitor Well Installation

A total of 17 new groundwater monitor wells will be installed in the vicinity of the Midway Landfill, at approximate locations shown on Figure 3. A two-phased approach will be used to drill and install the wells, with wells W1-W8, W11, and W15 (along with the three leachate wells) included in the first phase. Subsequently, wells W9, W10, W12-W14, W16, and W17 will be drilled and installed. The two-phased approach will allow the wells in those areas deemed most critical to be installed on a fast-track basis. Some of these new wells will screen the uppermost water table, while selected wells will be drilled below the water table to determine geology and water levels with depth. The anticipated depths and screened intervals of new monitor wells are given in Table 1. Actual boring depths and screen intervals will be determined in the field by project team geotechnical engineers and hydrogeologists.

In order to determine whether significant differences exist in the water quality between the upper water table and water table beneath the confining layer, dual completion wells will be placed at locations W1-W3, W5, W11, W13, and W15. Dual completion wells will be completed in a single boring, and one or two gas probes will be installed in selected monitor well boreholes. A schematic drawing of the proposed installation technique for dual completion wells and probes is shown in Figure 4.

The drilling techniques to be used include the hollow stem auger technique and the cable tool method. Although the hollow stem auger drilling technique provides excellent geologic samples, the method is generally limited to depths of about 100 feet. The method will not be applicable to all monitor well completions because the water table appears at depths of over 100 feet in portions of the site area. An alternate drilling technique that provides sufficient geologic sampling control is the cable tool method, which will be utilized to install monitor wells at depths beyond the capability of the hollow stem auger. Other drilling techniques including the "Odex" drilling method or variations of the air rotary method will be used if unusual or difficult drilling conditions are encountered.

Geologic samples will be collected during drilling of the boreholes. Samples will be collected at 5 foot intervals by driving a core sampler ahead of the borehole into undisturbed earth materials. The core sampler will be cleaned between uses with a detergent solution, followed by tap water and distilled water rinses.

The depth of monitor well completion will be selected based on the geologic characteristics and relative degree of saturation of formations penetrated. Screens in water table monitoring wells will be placed such that the tops are above the water table to allow for fluctuations. Upon reaching the appropriate depth, a 2-inch diameter PVC well screen and riser pipe will be installed through the auger (hollow stem) or casing (cable tool). The annulus around each well screen will be filled with an appropriately sized sand pack, followed by a bentonite pellet seal. A bentonite slurry grout seal will then be placed around the PVC casing up to land surface, or to the elevation of the next well or probe screen for dual completion wells. Each seal will be allowed sufficient time to set prior to continuing with additional borehole operations. The augers or casing will be pulled during the backfill process, ensuring that the sand and gravel pack and seal are securely installed.

The wells will be secured at land surface by an appropriate diameter steel protector pipe or a steel flush-mount valve box or monument, depending on the location of the well. A locking cap will be installed on each valve box or monument to provide security for well caps. A permanent water level measuring point will be inscribed on each PVC well casing, and this measuring point will be leveled by a licensed surveyor to the nearest 0.01 foot mean sea level datum during the ground survey task.

Augers and other down-hole components of the drilling rig will be steam cleaned prior to drilling at the site, between boreholes, and prior to leaving the site. Monitor well casings and screens will be steam cleaned prior to installation. Cuttings and fluids from the drilling operation will be stockpiled on the landfill property for appropriate disposal.

C. Hydraulic Conductivity Determinations

Selected core samples of sand and gravel strata will be submitted to a soils laboratory for grain size analysis. Selected fine grained strata (silt, clay) encountered in boreholes will be sampled with a Shelby tube and tested for vertical hydraulic conductivity. Slug tests (rising and falling head) will be performed on all new monitoring wells to determine hydraulic conductivity of the water bearing formations penetrated.

D. Monitor Well Sampling

A dedicated bladder type displacement pump will be installed in each new monitor well, with access for manual measurement of water levels and attachment of equipment to power the pump. Existing monitor wells, and water supply wells used as background indicators, will be sampled using in-place pumps or appropriate bailers or pumping devices carried into the field.

Prior to initial sampling, a complete round of water level measurements will be made for all existing monitor wells and the volume of water standing in each casing will be calculated. An appropriate number of casing volumes will be evacuated prior to collecting the sample from the pump discharge or by bailer.

Prior to initiation of drilling activities, the 14 existing usable monitor wells (groundwater and leachate wells installed by the City of Seattle) will be sampled, including MW-1, MW-2A, MW-3, MW-4, MW-7, BH-1A, BH-1B, and BH-2 to BH-8. Additionally, two water wells identified from the water well inventory in the local area will be sampled to determine background water quality for the local groundwater resource. As each new groundwater and leachate well is completed and tested during the first phase of the drilling program, it will be initially sampled. Data from sampling of the existing and newly installed first phase wells will then provide information which will be used to finalize the location of second phase well installations. During the second phase of well installation, each well will be sampled as it is installed and developed. At the completion of the second phase of well installation, a second round of sampling will be conducted on all completed wells. Thus, at the conclusion of the monitor well installation program, each existing and newly installed well will have been sampled twice. Additional sampling rounds will then be conducted at intervals of approximately 12 weeks, allowing two weeks for well purging and sample collection and ten weeks for laboratory analysis of samples and interpretation of water quality data. Each monitor well and water supply well will be sampled a total of four times during the RI monitoring period, providing for seasonal variations in water quality and insuring a minimum number of samples for statistical evaluation of the data base.

Each sample will be tested for field parameters as soon as it is collected. Parameters will include pH, conductivity, and temperature. A Microtox measurement will also be made to determine sample toxicity using indicator bacteria which react rapidly to toxic stress. A head space analysis will also be conducted on appropriate sample containers using the OVA GC/FID to detect total organics and to develop a chromatographic fingerprint of each sample. Samples for metals will be passed through a 0.45 micron filter prior to preservation with acid. Other samples will be placed in appropriate bottles and preserved according to the applicable analytical technique. All samples will be accompanied by a chain of custody form. Field measurements and well evacuation procedures will be recorded and included in the sampling record.

In addition to sample collection in monitor wells, water level measurements will be made on a monthly basis during the RI field investigation period at each existing well site. Water level measurements will also be made at the time of sampling of each well.

E. Water Sample Analysis

In addition to the field parameters and water level measured at the time of sample collection, groundwater and leachate samples will be analyzed in the laboratory for the parameters listed in Table 3. These parameters are based on constituents typically found in landfill leachate, and results of chemical analysis for samples from existing monitor wells at the Midway Landfill (City of Seattle, 1985). This list of parameters was selected to allow characterization of background water quality from water supply wells used for that purpose and delineation of contamination by landfill leachate.

Since hazardous substances or materials containing hazardous substances were disposed of at the landfill, priority pollutant analyses will be conducted on all initial samples in addition to those parameters included in the State of Washington Minimum Functional Standards for solid waste facilities. CERCLA guidance requires this approach to insure that site characterization bias is not introduced due to limited analysis of samples based on predicted or likely types and levels of contamination.

Upon receipt of the data from the initial analyses, an attempt will be made to correlate the degree of contamination present with indicator parameters. If such a correlation can be made, subsequent rounds of sampling may proceed with analysis of selected indicator parameters. Likely candidates for such parameters are indicated by the presence of an asterisk in Table 3. Decisions regarding parameter selection for groundwater and leachate samples will be made based on the water quality data accumulated during each sampling round and any trends which develop during subsequent rounds.

2.2.3 Surface Water Quality Investigation

The objectives of the surface water quality investigation at Midway Landfill are listed below:

- o evaluate the effect of infiltration upon leachate production
- o measure the quantity and quality of stormwater entering the landfill from the I-5 drainage area
- o determine what effect precipitation induces upon monitoring well levels and evaluate the effect on well levels from the onsite North and Middle ponds
- o identify and characterize surface seeps in the area adjacent to the landfill

2.2.3.1 Existing Data

A limited amount of data is available to quantify the amount of inflow resulting from the I-5 drainage system. Water level plots produced from monitor wells located onsite do not indicate a clear trend with relation to influent stormwater. The configuration of the drainage piping network within the landfill has not been clearly defined. Water quality measurements are available for the water that is trucked out of the landfill from the North Pond, but water level measurements have not been recorded for the pond.

At present two subsurface zones of saturation have been identified. One is above the water table and is a more or less isolated body of water. The other water table is much deeper and occurs within the Advance Outwash. However, both zones of saturation are believed to be recharged by precipitation falling in or around the landfill, from ponded surface water around the perimeter of the landfill, and from surface water directed into the landfill from east of I-5.

As previously reported ("Forward Planning Document, Midway Landfill", Black & Veatch, 1985), the landfill does not yield surface water out of its boundaries. The three ponds located on the property receive on and offsite drainage, as well as seeps from the fill material.

2.2.3.2 Sample Collection and Analysis Rationale

The sampling program for assessing surface water will include the use of flow measurements and physical/chemical analysis. To quantify the amount of storm water entering the site, flow meters will be placed at the culvert that enters the landfill at the northeastern corner, and at the manhole located east of the site, as indicated on Figure 7. The flow meters to be used will be level sensor meters (ISCO type) that will be triggered during storm events. It is expected that at a minimum, two storm events will be monitored. To assess whether influent stormwater induces changes in water quality, a limited analysis will be done on the composite stormwater samples. The parameters for the analyses are listed in Table 4. Information will be gathered at the meterological stations (addressed in a later Air Quality Monitoring section) concerning the duration of the storm events and the amount of rainfall and evaporation.

To evaluate the amount of runoff entering the Middle and North ponds, staff gauges will be placed in each pond with levels marked in 0.01-foot gradations. Daily readings of the gauges will be taken throughout the duration of field activities. A survey of the ponds will be completed to determine their volume and capacity. Samples will be collected and analyzed from each pond in accordance with the parameters summarized in Table 5.

A field reconnaissance survey will be made to determine where seeps are located around the landfill, and at what times seepage is present. Selected seeps and shallow gas probes which contain standing water will be sampled at least once for those compounds listed in Table 5. It is expected that approximately 20-25 liquid samples will be analyzed. In addition, approximately 20 soil samples will be collected at selected seeps or related offsite locations and analyzed for those parameters shown in Table 6.

2.3 GAS EMISSION AND AMBIENT AIR INVESTIGATIONS

Gases produced by the landfill require further characterization. Subsurface migration of methane has produced measured concentrations above the lower explosive limit in offsite residential and commercial buildings and in a high percentage of the offsite gas probes installed by the Department of Ecology and the City of Seattle. Emissions of methane, sulfides and organic compounds to ambient air may produce concentrations of some substances exceeding health and safety guidelines. Both gas transport pathways, subsurface and ambient air, require assessment during the undisturbed state as well as during remedial action efforts. These pathways will be addressed separately in this section.

The City of Seattle is currently implementing a gas control plan for Midway Landfill. The plan consists of installing an active gas venting system within the landfill and burning the gas in a flare system on the site. The system is currently operating on an interim basis with a more permanent exhaustor and flare system to be installed during the summer of 1986.

The Department of Ecology and the City of Seattle have also installed gas extraction systems at offsite locations to the east and northwest of the landfill site in an effort to remove subsurface gas in residential and business areas adjacent to the landfill boundary.

2.3.1 Subsurface Gas Migration

2.3.1.1 Objectives

The objectives of the sampling activities associated with subsurface gas migration are to:

- o expand the current landfill gas monitoring and sampling data base
- o determine effectiveness of the Midway Landfill gas control system
- o better estimate the present extent of landfill gas migration
- o identify migration conduits and landfill gas accumulation points
- o determine predominant transport mechanisms
- o determine compositional changes in gas as it migrates away from the landfill
- o determine effectiveness of offsite gas extraction systems and determine the need for additional offsite controls

2.3.1.2 Existing Data

Primary sources of existing data related to subsurface gas migration are: (1) periodic methane concentration measurements made by the Seattle Engineering Department at gas probes in the landfill and at several nearby areas, (2) weekly to biweekly methane concentration measurements made by City of Seattle consultants and local and state agencies at permanent gas probes outside the landfill, (3) gas composition measurements made by University of Washington personnel at three flares in the landfill (July, 1985), (4) well logs and construction diagrams prepared by Golder & Associates for the permanent gas probes outside the landfill (June, 1982 and July, 1985), (5) boring and installation logs for 73 shallow gas probes, 10 deep gas probe clusters, and two gas extraction wells installed by the Department of Ecology, and prepared by Black & Veatch and Hart-Crowser & Associates (Oct, 1985 to Feb, 1986), and (6) monitoring data for Ecology gas probes and gas extraction wells (Dec, 1985 to April, 1986).

This data, especially the methane concentrations at the permanent probes, has indicated that explosive conditions exist in a relatively large area surrounding the landfill. Measurements of combustible gas levels both on- and offsite have shown levels greater than 60 percent by volume. Although the data that are presently available do not allow the full extent of landfill gas migration to be estimated with a high level of confidence, methane concentrations do exceed the lower explosive limit (4 percent methane by volume) over distances greater than 1,000 feet from the landfill boundaries. Furthermore, laboratory analyses performed on samples from landfill flares indicate that the gas migrating away from the landfill could contain hydrogen sulfide, benzene, and other hydrocarbon compounds in concentrations sufficient to be of concern with respect to public health if emitted into ambient air.

Several gaps can be identified in the existing data. These gaps can be categorized into four general groups:

- data needed to determine total and partial pressure gradients in lines perpendicular to the landfill

- data pertaining to the composition of the landfill gas as it migrates from the site

- o data describing manmade and natural migration conduits and accumulation points, and the rate and extent of migration

- o data defining geologic stratigraphy and material properties

2.3.1.3 <u>Sample Collection and Analysis Rationale</u>

A. <u>Gas Probe Installation</u>

Seventy-three shallow (10 foot) gas probes and eleven deep (up to 100 foot) gas probe clusters have been installed recently by the Department of Ecology around the landfill to assess gas migration in the most important subsurface zone. The City of Seattle previously installed several gas probe clusters for the same purpose. Gas may be migrating through the soil and through various subsurface conduits such as utility pipes and vaults, emerging at breaks in the soil surface such as basement excavations and at sewer manholes and other utility surface projections, and through natural vents or cracks in the soil surface. The system of shallow probes is designed to detect gas in this upper subsurface zone in a 500-1,000 foot perimeter around the landfill in a systematic manner to detect explosive concentrations at or near the ground surface.

In addition to existing gas probe installations, at least six additional clustered gas probes will be installed during the RI field investigation at locations of existing shallow probes as shown on Figure 3. Each probe cluster will consist of two probes screened at depths of approximately 10 to 50 and 60 to 100 feet, respectively, as summarized in Table 2. The locations of the new gas probe clusters will be selected to complement data being collected from existing probes and eight to ten deep gas probe clusters being installed under an ongoing separate work assignment related to gas migration issues.

A typical construction diagram for the probe clusters is presented in Figure 6. Borings for the probes will be drilled with a hollow stem auger or by the cable tool method with split spoon sampling at 5-foot depth intervals. Grain size analysis will be performed on selected samples. Each borehole will have a maximum depth of 100 feet and will be completed above the groundwater table. It is not expected that significant gas migration is occurring in the saturated zone below the uppermost water table.

Additional gas probes will be installed at selected monitor well locations as shown in Table 2 and in Figure 3. The exact number and locations for these probes will depend upon the stratigraphy that is observed at the time of installation. Monitor well probes will consist of 1/2 to 3/4-inch Schedule 80 PVC casing with 0.02 inch slotted screen. Length of screen will depend on the stratigraphy encountered at each borehole. Deeper probes will generally have longer screen intervals.

Each sampling interval will be surrounded with sand and gravel packs that will be sealed above and below with at least two feet of bentonite. The bentonite seal will be formed from bentonite pellets or from a finer granulated bentonite material to ensure proper placement around the casings and a secure seal to prevent interzonal migration within the borehole.

B. Gas Probe Monitoring and Sampling

Landfill gas monitoring is currently being conducted for shallow and deep probes and for selected surface locations in residential and commercial buildings under the direction of the Department of Ecology and City of Seattle Engineering Department. Monitoring for these locations is limited primarily to combustible gas concentration with the objectives of identifying areas where explosive gas concentrations may exist and determining extent of gas migration. The location and construction details of existing City of Seattle probes are presented in the "Draft Environmental Impact Statement for Midway Sanitary Landfill Closure,", (Seattle Engineering Dept, August, 1985) and selected probe locations are also indicated as "existing" probes on Figure 3. Locations of Department of Ecology shallow and deep gas probe clusters are summarized in the draft "Gas Monitoring Report" by Black & Veatch, Feb, 1986. Landfill gas monitoring and sampling to be conducted in accordance with this sampling plan is intended to enhance the existing data base and provide additional data to achieve the objectives of the gas monitoring and sampling task of the remedial investigation.

Gas monitoring will be conducted using the following procedures:

- The new system of shallow gas probes and deep probe clusters and selected existing City of Seattle probes will be monitored in a time-correlated sequence. Exact sequence will be determined by the field monitoring team and approved by Ecology.

- Several discrete rounds of monitoring will be conducted on selected probes including approximately 50 percent of shallow probes and all operable deep probe clusters. Based on the results of ongoing gas monitoring, one or more intensive gas monitoring surveys consisting of several measurements of key parameters in a 24 to 48 hour period may be conducted for selected probes or within selected geographic boundaries. The equivalent of five complete monitoring rounds for all installed gas probes will be completed during the RI monitoring period.

- Measurements at gas probes will include gas pressure and temperature, combustible gas concentration, hydrogen sulfide, oxygen, carbon dioxide, and organic vapor analysis in a survey mode (total organics). In addition, barometric pressure will be continuously monitored at an appropriate location near or at the landfill during gas monitoring activities.

- Organic vapor analysis will be conducted in the chromatographic mode at selected monitored probe locations in order to semi-quantitatively "fingerprint" the VOC gas components.

- Gas samples will be obtained at approximately five (5) of the probe locations with highest organics concentrations or unique chromatographic pattern, during each round of monitoring. Samples will be obtained using an appropriate pumping device in Tedlar air bags or, alternatively, on Tenax resin or activated carbon collector tubes. Samples will be extracted in the laboratory and analyzed for the parameters in Table 7.

- Gas pressure measurements will be obtained with a portable manometer. These measurements will be used to determine if the methane transport mechanism is dominated by total pressures (advective transport), partial pressures (diffusional transport), or a combination of both.

- Carbon dioxide measurements will be obtained with a portable gas detector or detector tubes. The presence of carbon dioxide will help verify that the source of the methane is the landfill.

- o Organic vapor analysis will be completed using a portable organic vapor detector which can be set to measure total organics in a survey mode, or can be attached to a data recorder and set in chromatographic mode to obtain a relative chromatograph, calibrated to a known compound, which will yield a chromatographic "fingerprint" or trace of those organics which elute through the chromatographic column during a preset measurement period. Comparison of chromatographs produced by this method will indicate the relative distribution of organic vapors at various probe locations and will yield quantitative data for those organics which produce a complete trace relative to a standard instrument calibration. Chromatographic data obtained by this technique will be verified by comparison with laboratory GC data from duplicate gas samples.

Data obtained by the above gas monitoring methods and procedures will be analyzed in accordance with task objectives to determine the extent of gas migration, gas characteristics, and gas control system effectiveness.

C. Identification of Gas Migration Conduits

An inventory will be conducted to identify possible migration conduits and accumulation locations for the landfill gas. The inventory will include sewer lines, drainage pipes, buried utility lines, basements, crawl spaces, and culverts. The primary source of information for this inventory will be existing maps and records. A significant amount of buried utility information has been generated during installation of shallow gas probes as each probe site is marked by the local utility locator service. The continuation of this data gathering will concentrate on areas already known to be areas of gas accumulation.

Spot checks of combustible gas concentrations at points identified in the inventory as probable gas accumulation locations will be performed by the remedial investigation field team using a portable gas detector. If any of these additional measurements indicate the presence of combustible gases, recommendations will be made for a more extensive monitoring program to be implemented.

2.4.2 Ambient Air Quality

2.4.2.1 Objectives

An ambient air quality investigation will be performed as part of the remedial activities to be conducted at Midway Landfill. The objectives of the investigation are summarized as follows:

- o define the extent of landfill gas emissions into ambient air on and around the landfill site

- o characterize the composition of the gases emitted by the landfill, with particular attention devoted to identifying and quantifying organic components and compounds containing sulfur

- o estimate exposure levels from landfill gas on both on- and offsite receptors, both for the undisturbed state of the landfill and conditions occurring during remedial investigations

- o development of information to be used in assessing the performance of onsite and offsite gas control systems installed by the Department of Ecology and the City of Seattle as well as information relating to development of additional remedial measures, if required

2.3.2.2 Existing Data

A number of air quality monitoring efforts have been conducted to date at the Midway Landfill site. These have included monitoring of flare gas emissions at the site for use in development of a site safety plan for well drilling and installation activities (Laucks Testing Laboratories, April, 1984), an air quality modeling effort (University of Washington, May 1985), and onsite measurement of combustible gas levels. The results of the monitoring programs indicate that hydrogen sulfide, methane, and a wide variety of organic trace components comprise the landfill gas. The trace components include aromatic compounds as well as many of the "EPA Priority" chlorinated solvents, such as chloroethane, methylene chloride, dichloroethane, trichloroethane, carbon tetrachloride, trichloroethylene, tetrachloroethane, and tetrachlorethylene. Also present in the flare gas are a number of compounds associated with odor problems, including butanoic acid esters and terpenes.

Using results of the sampling of the flare emissions and assumptions regarding flare operations, a standard EPA dispersion model was used by the University of Washington (1985) to estimate offsite impacts of landfill gas emissions. Results of the model predictions were reasonable approximations to observed values for meteorological conditions occurring during sampling.

Further dispersion model predictions were made for the assumed worst-case conditions, which were light northerly winds during slightly stable conditions. These conditions were estimated to occur about 2 percent of the time. Concentrations predicted during these conditions exceeded guideline values for benzene and hydrogen sulfide at offsite locations in ambient air.

Odor problems were addressed in the University of Washington report. Numerous public complaints have been made by individuals residing or working to the east, south, and west of the landfill. Odor complaints have been made during a wide range of meterological conditions, and may be correlated with the efficiency of past flaring operations.

2.3.2.3 Sample Collection and Analysis Rationale

The air quality investigation will include the following work elements:

- Source monitoring of the City of Seattle gas control system temporary flares or permanent flare (point source)

- Source monitoring of the existing landfill surface prior to final closure and selected offsite locations with extensive gas emissions (diffuse source)

- Source monitoring during leachate well installation activities (point source)

- Ambient air and meteorological monitoring onsite at one fixed monitoring station and one mobile monitoring location on a continuous or semi-continuous basis

- Ambient air and meteorological monitoring offsite at three mobile monitoring locations on an event basis

Each of these areas of investigation is described in detail in the following sections. Additionally, because of the threat of fire or explosion caused by combustible landfill gas emissions, initial remedial measures (IRM'S) have been instituted under the air quality investigation task. The IRM's are described in a technical memorandum "Initial Remedial Measure Recommendations - Midway Landfill", Black & Veatch, August, 1985, and include the use of combustible gas instruments to measure gas concentrations in offsite residential and comercial buildings and the temporary closure of one adjacent business. Additional IRM's have since been instituted including additional building evacuations and installation of several offsite gas extraction systems.

A. Source Characterization of Gas Control System and Flare

The City of Seattle has implemented a gas control plan at the Midway Landfill which includes a curtain of gas extraction wells around the perimeter of the landfill attached to a blower system and a terminal flare to burn the collected gas. The system is currently operating in a temporary mode with portable blowers and flares at several locations onsite. When the system is completed, the entire collection system will be connected to a single stationary blower and flare system. It is assumed that this system will be in place at the time of remedial air quality investigations.

The gas collection system will be sampled at an internal collection point which is representative of the homogeneous gas being collected from the entire landfill, to determine pertinent landfill gas characteristics including:

- o gas flow rate
- o gas moisture content
- o gas temperature
- o hazardous substances analysis

- o hydrogen sulfide (H_2S)

- o hydrogen cyanide (HCN)

- o hydrogen chloride (HCl)

- o carbon dioxide (CO_2)

Gas flow rate will be determined from operating characteristics of the gas control system blower equipment when operating in a normal mode. If necessary, a portable manometer will be attached to the system at an appropriate location and gas flow rate calculated from pressure measurements and other gas characteristics. Gas temperature will be measured at an appropriate location in the collection system. Gas flow rate and temperature may be available from sensors which are an integral part of the gas control equipment. Gas moisture content will be measured by obtaining a sample from the collection system at an appropriate location and absorbing water vapor on an appropriate dessicant material.

Chemical characteristics of the raw gas stream will be determined by both field and laboratory analysis of representative gas samples from the gas collection system. Field analysis will include Drager tube analysis for H_2S, HCN, HCl, and CO_2. Field analysis of organics will be conducted using an organic vapor analysis (OVA) instrument in the chromatographic mode, and a more detailed continuous chromatographic analysis using a self-calibrated portable gas chromatograph attached to the gas collection system. Tedlar air bags, or alternatively, Tenax resin or activiated carbon collection tubes will be used to obtain time-weighted gas samples for hazardous substance confirmation in a laboratory environment. Samples will also be obtained, using an appropriate air sampling technique, for laboratory confirmation of H_2S and HCN concentrations.

The gas flare will be sampled while operating in a normal mode in a downwind direction, at a distance from the flare determined to be sufficient that combustion is complete and radiant heat low enough that sample probes are not affected by the temperature. Samples taken at this location will be used to characterize the post-combustion gas stream prior to complete diffusion in ambient air. The primary purpose of this sampling technique will be to determine efficiency of the combustion process and detect the presence of any uncombusted organics. Field measurement techniques will include use of detector (Drager) tube, the OVA instrument in survey and chromatographic mode, the self-calibrating portable gas chromatograph in real-time mode, and Tedlar air bags or time weighted carbon/resin collection tubes for subsequent laboratory analysis. Parameter list for organics confirmation will be the same as for the raw gas stream.

Two separate sampling events, including a full suite of field and laboratory measurements, will be conducted for the gas collection system and flare.

B. Characterization of Landfill Area Diffuse Gas Emission

The City of Seattle plan for closure of the Midway Landfill includes capping of the entire surface area with a low permeability soil to prevent intrusion of surface water and reduce diffuse gas emissions. The nature and significance of diffuse gas emission from the landfill and adjacent areas has not been investigated to date. It is assumed that implementation of the gas control system will reduce diffuse gas emission but no data is available to determine or estimate the effect of the gas collection system. It is also assumed that final capping of the site will not be accomplished prior to the air quality remedial investigation.

Characterization of diffuse gas emission will be accomplished using an emission isolation flux chamber (described by Radian Corporation, 1984). The use of the flux chamber allows for the determination of the amounts of a single compound or multiple compounds being emitted from a given surface area per unit time. The information obtained from the flux chamber analysis can then be used in predictive models for population exposure assessments (endangerment assessments) and for evaluation and design of remedial action alternatives, including site capping.

Figure 8 illustrates schematically the emission isolation flux chamber. The unit consists of a stainless steel/acrylic chamber with air mixer, thermocouple, ultra-pure sweep air and rotameter for measuring flow into the chamber, and a manifold for sample collection or instrument connection. The unit is designed to be portable. However, at each sampling location, an in-ground stainless steel or acrylic-covered steel collar will be installed for the duration of the test at that location. The use of the collar assures an integral seal for each sampling event.

A minimum of six landfill sampling sites and six offsite sampling locations will be selected to conduct isolation flux measurements. General sampling locations will be selected by consideration of physiography, soil types, areas of known gas emission, and similar site criteria. Exact flux chamber sampling sites will be determined by dividing the general sampling areas into 200' by 200' grids and running OVA GC/FID transects in total organics mode over the grids. If significant points of emission are detected, the sampling point will be the point of maximum gas concentration. If organics are not detected in significant concentrations, sampling sites will be chosen at random within each grid.

In order to determine variations in diffuse gas emission which may be caused by diurnal heating and cooling or barometric pressure changes, at least one sampling site will be operated in an intensive survey mode over a 24 to 48 hour time period. The portable self-calibrating GC/FID detector will be operated in real-time mode to determine changes in gas diffusion rate and composition.

Isolation flux chamber surveys will be conducted in two phases, onsite and offsite, and will be linked to the schedule for other gas emission and air quality investigations so that data from the diffuse gas surveys can be correlated with other relevant data. Surveys will be spread over enough time that seasonal variations in gas emissions can be estimated.

C. Characterization of Air Emissions During Leachate Well Installation

Procedures as described in the site Health & Safety Plan will be fully implemented during installation of onsite leachate monitoring wells. These procedures include continuous monitoring in the "hot" zone around the drill site for combustible gas concentration, hydrogen sulfide concentration, oxygen concentration, and non-methane organics concentration. In addition to the required procedures and continuous measurements, an OVA instrument will be used in the chromatographic mode to "fingerprint" gas emissions from the leachate well borehole at 20-foot intervals during drilling of each borehole. Additionally, onsite meterological and air quality instruments will be utilized to estimate ambient air impacts of leachate well drilling activities. The self-calibrating portable gas chromatograph will be utilized during this period of ambient air measurement to characterize ambient air downwind of the drilling activity on a real-time basis.

D. Onsite Meterorlogical and Ambient Air Monitoring

Studies conducted for the City of Seattle (Univ of Washington, 1985) have suggested further monitoring onsite using an upwind-downwind methodology and a standard air quality dispersion model to further characterize ambient air quality and enable prediction of "worst case" offsite air quality constituent concentrations for specified meteorological conditions. Procedures for onsite ambient air monitoring will utilize the recommended methodology to further define onsite ambient air quality during various meteorological and field activity conditions including the following:

- o critical or "worst case" wind direction and velocity as indicated by the Univ of Washington researchers.
- o representative easterly wind direction and velocity (to the east)
- o representative southerly wind direction and velocity (to the south)
- o representative westerly wind direction and velocity (to the west)
- o during onsite leachate well installation activity
- o during onsite diffuse gas emission survey activity
- o during normal gas control system flare conditions
- o during flare-out gas control system conditions, if allowed by local air quality agencies and approved by the City of Seattle

To accomplish controlled onsite ambient air monitoring during these conditions, a complete remote operated meteorological station will be installed onsite to obtain local meteorological data including: wind direction and velocity, dry and wet bulb temperature, barometric pressure, precipitation, and pan evaporation. Continuous or semi-continuous data will be collected by meteorological instruments as necessary during the entire period of the remedial investigation. Data will be collected by recordng pen or digital magnetic tape methods as appropriate.

The wind direction/velocity instrument will be attached to a dedicated portable computer which can be used to trigger on-off states for other instruments including an ambient air gas sampler or portable gas chromatograph. The attached air sampler will collect air samples as programmed (wind direction or time-weighted basis) on carbon/resin collector tubes. The portable self-calibrating gas chromatograph when triggered will collect and analyze real-time ambient air samples.

Two additional meteorological/air quality sampling stations as described above (wind direction and velocity only) will be utilized as mobile ambient air quality stations to obtain simultaneous air quality data downwind of the master station. One of these satellite monitoring stations will be installed at appropriate onsite downwind locations during sampling and monitoring events. Samples of ambient air will be collected on carbon/resin collector tubes in the same manner as at the master monitoring station.

Sample sets will be collected for laboratory analysis using carbon/resin tubes as specified below for the proposed monitoring events:

	Monitoring Station	
Event	Master	Onsite Satellite
"Worst Case" Wind Direction & Velocity	2 sets	2 sets
Easterly Wind Direction & Velocity	2 set	2 set
Southerly Wind Direction & Velocity	2 set	2 set
Westerly Wind Direction & Velocity	2 set	2 set
Diffuse Gas surveys	1 set	1 set
Normal Flare Conditions	1 set	1 set
Flare-out Conditions (if approved)	1 set	1 set

All samples will be desorbed and analyzed in the labratory for the parameters listed in Table 7. Simultaneous portable GC measurements will be made on a real-time basis during selected events at either the master or satellite monitoring stations.

E. Offsite Meterological and Ambient Air Monitoring

A satellite meteorological/air quality station including wind direction and velocity and an automated air sampling assembly will be installed at appropriate offsite locations to the east, south, and west of the Midway Landfill to obtain offsite air samples in coordination with the overall air quality investigation. Samples will be collected in the same manner as for onsite air monitoring stations. Three discrete events will be monitored in a sequential manner as follows:

Event	Number of Samples
Easterly Wind Direction & Velocity	2 sets
Southerly Wind Direction & Velocity	2 sets
Westerly Wind Direction & Velocity	2 sets

The duration of sampling events will be programmed to take into account the expected low concentrations of any landfill gas constituents with distance from the landfill.

Meteorological and air quality data will be collected continuously or semi-continuously during the duration of the overall remedial investigation. Meteorological data collected during this period will be correlated statistically with simultaneous data collected at the nearby SEATAC airport. It will then be possible to utilize the long term data base for the SEATAC airport to estimate meteorological conditions for Midway Landfill for events other than those directly measured. These comparisons will be fed as input data to the established air quality model using actual or simulated air quality data to predict a wide range of offsite air quality scenarios, as appropriate.

2.4 IDENTIFICATION OF RECEPTORS

2.4.1 Receptor Field Investigation

2.4.1.1 Objectives

The objectives of this portion of the field investigation will be to identify those populations which are exposed to hazardous substances or conditions emanating from the Midway Landfill site. The objectives include the identification of the types of populations, sizes, and distribution of the populations at risk.

2.4.1.2 Existing Data

The receptor populations can be divided into two broad groups including human population and wildlife resources (including flora and fauna). The draft Environmental Impact Statement for Closure - Midway Landfill completed by the City of Seattle, while addressing closure alternatives, identified onsite and offsite vegetation and wildlife resources within the general remedial investigation study area. The Seattle-King County Department of Public Health provided a list of those residences that have been monitored for combustible gas levels in the Midway area.

2.4.1.3 Data Collection and Analysis Rationale

During the data collection phase of the receptor field investigation, information will be developed describing the number of people in the area who may be at risk from the following factors:

- gas migration
- exposure to airborne hazardous substances
- exposure to or consumption of leachate-contaminated groundwater

The number of employees at nearby businesses will be determined. A review of the vegetation and wildlife inventory included in the Midway Landfill draft Environmental Impact Statement will be conducted to determine the adequacy of the existing data base for evaluating natural resource receptors. Planning documents available from local and state agencies will be reviewed to determine the existing population density within the study area, population movement patterns, and exposure potential. Future growth and development trends will also be reviewed and assessed with respect to potential for new receptors to emerge in the study area.

TABLE 1

APPROXIMATE DEPTHS AND SCREENED INTERVALS
FOR
PROPOSED GROUNDWATER AND LEACHATE MONITORING WELLS

WELL NUMBER	ESTIMATED DEPTH TO WATER (FT)	APPROXIMATE WELL DEPTH (FT)	APPROXIMATE SCREEN INTERVAL (FT)	WORK PHASE
W1 (d,p)	55	95	50-65; 85-95	1
W2 (d,p)	90	130	85-100; 120-130	1
W3 (d,p)	130	170	125-140; 160-170	1
W4	>175	300	270-300	1
W5 (d,p)	120	160	115-130; 150-160	1
W6	150	190	180-190	1
W7	100	110	95-110	1
W8	95	160	150-160	1
W9 (p)	50	60	45-60	2
W10 (p)	80	90	75-90	2
W11 (d,p)	85	125	80-95; 115-125	1
W12 (p)	105	115	100-115	2
W13 (d,p)	140	180	135-150; 170-180	2
W14 (p)	220	230	215-230	2
W15 (d)	180	190	175-190; 210-220	1
W16	125	135	120-135	2
W17	80	90	75-90	2
L1	40	70	35-50	1
L2	80	110	75-90	1
L3	70	100	65-80	1

d = dual completion
p = includes gas probe(s)

Notes: 1. Well depths and screen intervals are based on review of available geologic data.

2. Total depth of borings for leachate monitor wells will be sufficient to characterize till and advance outwash strata below fill material. Borings will be backfilled using appropriate techniques to an elevation above the fill boundary prior to installation of leachate monitor wells.

TABLE 2

APPROXIMATE DEPTHS AND SCREENED INTERVALS
FOR
PROPOSED GAS PROBES

GAS PROBE NUMBER	ADJACENT GW WELL	APPROXIMATE DEPTH (FT)	APPROXIMATE SCREEN INTERVALS (FT)	WORK PHASE
G1	W1	55	10-55	1
G2		100	10-50; 60-100	1
G3	W2	90	10-40; 50-90	1
G4		100	10-50; 60-100	1
G5	W3	100	10-50; 60-100	1
G6		100	10-50; 60-100	2
G7		100	10-50; 60-100	2
G8		100	10-50; 60-100	2
G9	W5	100	10-50; 60-100	1
G10		100	10-50; 60-100	1
G11		100	10-50; 60-100	2
G12	W12	100	10-50; 60-100	2
G13	W11	85	10-40; 50-85	1
G14	W10	80	10-40; 50-80	2
G15		55	10-55	1
G16	W9	50	10-50	2

Note: See Table 1 for information on groundwater wells referenced in this table.

TABLE 3

LABORATORY ANALYSIS PLAN
FOR
GROUNDWATER AND LEACHATE MONITORING WELLS

PARAMETER	UNITS	NO. SAMPLES EACH WELL	POTENTIAL INDICATOR
Conventional Parameters (Including State of Washington Minimum Functional Standards)			
pH	pH	4	Field
Temperature	degrees C	4	Field
Conductivity	mmhos/cm	4	Field
Boron	mg/l	4	**
Calcium	mg/l	4	
Magnesium	mg/l	4	
Sodium	mg/l	4	
Potassium	mg/l	4	
Iron	mg/l	4	
Magnanese	mg/l	4	
Carbonate	mg/l	4	
Bicarbonate	mg/l	4	
Sulfate	mg/l	4	**
Sulfide	mg/l	4	**
Chloride	mg/l	4	**
Fluoride	mg/l	4	
Total Dissolved Solids	mg/l	4	
Ammonia Nitrogen	mg/l	4	
Nitrite Nitrogen	mg/l	4	
Nitrate Nitrogen	mg/l	4	
Total Kjehdahl Nitrogen	mg/l	4	
Hardness	mg/l CaCO3	4	
Alkalinity	mg/l CaCO3	4	**
Biochemical Oxygen Demand (BOD-5)	mg/l BOD-5	4	
Chemical Oxygen Demand (COD)	mg/l	4	**
Total Organic Carbon (TOC)	mg/l	4	**
Total Organic Halogen (TOX)	mg/l	4	**
Microbiological and Bioassay Methods			
Total Coliform	lb/100ml	4	**
Microtox	% dim.	4	Field

TABLE 3 (CONTINUED)

LABORATORY ANALYSIS PLAN
FOR
GROUNDWATER AND LEACHATE MONITIRING WELLS

PARAMETER	UNITS	NO. SAMPLES EACH WELL	POTENTIAL INDICATOR
CERCLA Hazardous Substances			
Total Cyanides	mg/l	2-4	
Dissolved Metals (Sb, As, Se, Ag, Th, Be, Cd, Cr, Cu, Ni, Pb, Zn)	mg/l	2-4	
Volatile Organics	mg/l	2-4	
Acid Extractable Organics	mg/l	2-4	
Base Neutral Organics	mg/l	2-4	
Pesticides	mg/l	2-4	

Note: 20 new monitor wells, 14 existing monitor wells, and 2 offsite water supply wells to be sampled 4 times each. Parameters marked "Field" will be measured in field. Parameters marked "**" are potential indicator parameters for sampling rounds 2 to 4.

TABLE 4

LABORATORY ANALYSIS PLAN
FOR
STORMWATER MONITORING

PARAMETER	UNITS	NO. SAMPLES	POTENTIAL INDICATOR
pH	pH	12	**
Specific Conductance	mmhos	12	**
Ions (B,Ca,Mg,Na,K,Fe,Mn,SO4)	mg/l	2	
SO2	mg/l	2	
Fluoride	mg/l	2	
Total Dissolved Solids	mg/l	12	**
Total Suspended Solids	mg/l	12	**
Total Kjeldahl Nitrogen	mg/l	2	
Nitrate Nitrogen	mg/l	2	
Phosphorus as PO4	mg/l	2	
Alkalinity	mg/l CaCO3	2	
Hardness	mg/l CaCO3	2	
BOD-5	mg/l BOD-5	2	
Chemical Oxygen Demand (COD)	mg/l	12	**
Total Organic Halogen (TOX)	mg/l	2	
CERCLA Hazardous Substances			
Dissolved Metals (see Table 3)	mg/l	2	
Volatile Organics	mg/l	2	
Acid Extractable Organics	mg/l	2	
Base Neutral Organics	mg/l	2	
Pesticides	mg/l	2	

Note: Based on sampling 2 - 24 hour storm events, with parameters marked "**" to be used as indicators of runoff quality. Indicator parameters will be analyzed from instrument grab samples obtained at 6 hour intervals.

TABLE 5

LABORATORY ANALYSIS PLAN
FOR
SURFACE WATER RUNOFF
AND SEEPS

PARAMETER	UNITS	NUMBER OF SAMPLES: SURFACE WATER	NUMBER OF SAMPLES: SEEPS
Field parameters			
pH	pH	25 - 30	20 - 25
Temperature	degrees C	25 - 30	20 - 25
Conductivity	mmhos/cm	25 - 30	20 - 25
Microtox	% dim.	25 - 30	20 - 25
Conventional Parameters			
(See Table 4 for list)		8 - 10	20 - 25
Fecal Coliform	lb/100ml		20 - 25
CERCLA Hazardous Substances			
Dissolved Metals (See Table 3)	mg/l	8 - 10	5 - 10
Volatile Organics	mg/l	4 - 6	5 - 10
Acid Extractable Organics	mg/l	4 - 6	5 - 10
Base Neutral Organics	mg/l	4 - 6	5 - 10
Pesticides	mg/l	4 - 6	5 - 10

TABLE 6

LABORATORY ANALYSIS PLAN
FOR
SURFACE SOILS AT SEEP LOCATIONS

PARAMETER	UNITS	NO. SAMPLES
Grain size analysis		20
pH (saturated paste)	pH	20
Conductivity (saturated paste)	mmhos/cm	20
CERCLA Hazardous Substances		
Dissolved Metals (see Table 3)	mg/kg	20
Volatile Organics	mg/kg	20
Acid Extractable Organics	mg/kg	20
Base/Neutral Organics	mg/kg	20
Pesticides	mg/kg	20

Note: Soils will be extracted using appropriate laboratory technique prior to analysis.

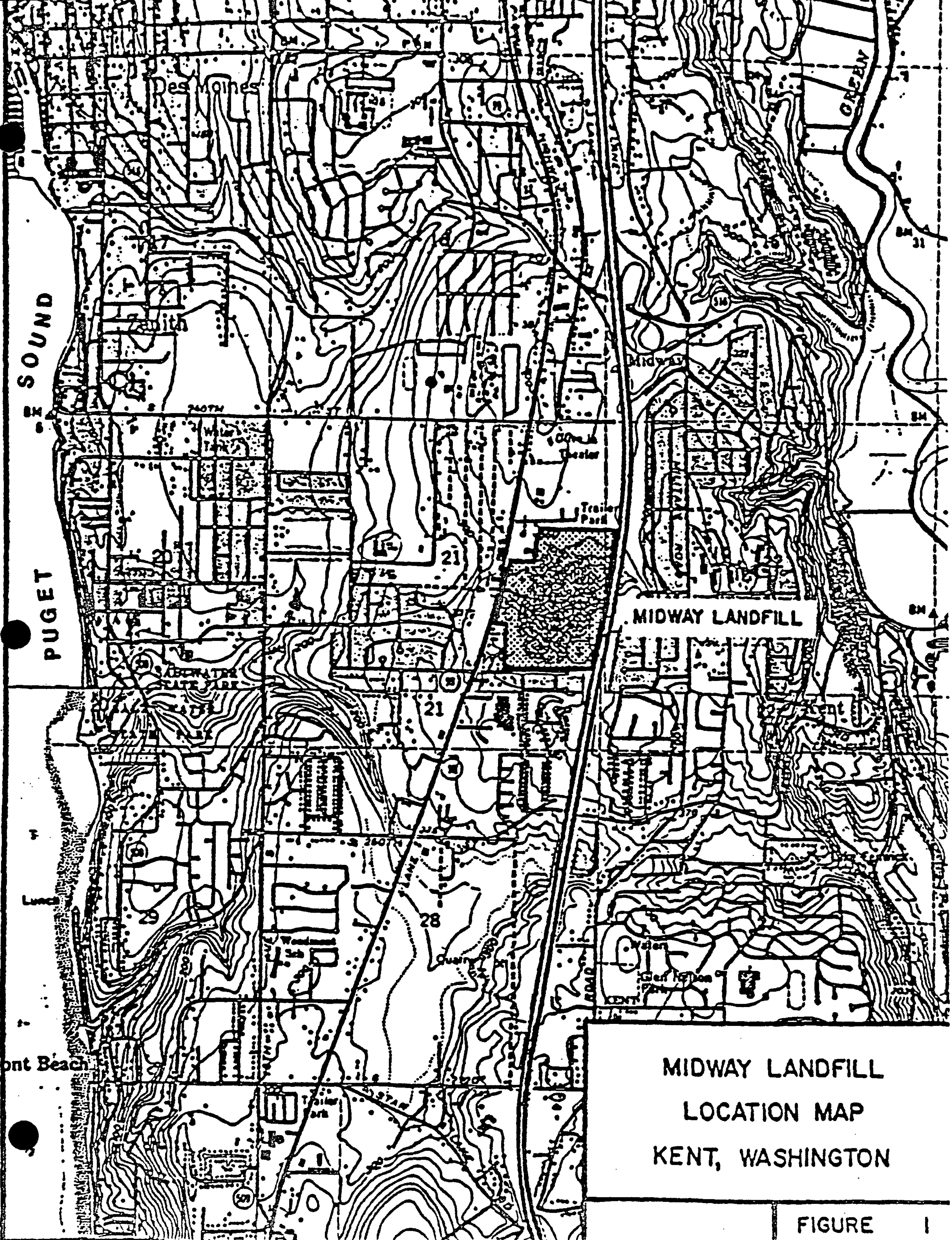
TABLE 7

LABORATORY ANALYSIS PLAN
FOR
LANDFILL GAS AND AIR QUALITY SAMPLES
USING DETECTOR TUBES OR TEDLAR AIR BAGS

PARAMETER	NUMBER OF SAMPLES AMBIENT AIR	NUMBER OF SAMPLES GAS PROBES
1,2-Dichloroethylene	28	25
Benzene	28	25
Carbon tetrachloride	28	25
Tetrachloroethylene	28	25
Trichloroethylene	28	25
Toluene	28	25
Chlorobenzene	28	25
Total Xylenes	28	25
Vinyl Cholride	28	25
Methlyene Chloride	28	25

Notes: 1. Parameter list based on historical flare sampling and recent gas probe and ambient air sampling. A complete CERCLA hazardous substances scan for volatile and semivolatile organics will be conducted on samples obtained from the gas control system. Based on those results, additional parameters may be added to the indicator parameter list.

2. Laboratory analysis will consist of sample preparation using cryogenic focusing technique, addition of H20 and standards, and GC/FID or GC/PID with GC/MS confirmation on selected samples.



MIDWAY LANDFILL
LOCATION MAP
KENT, WASHINGTON

FIGURE 1

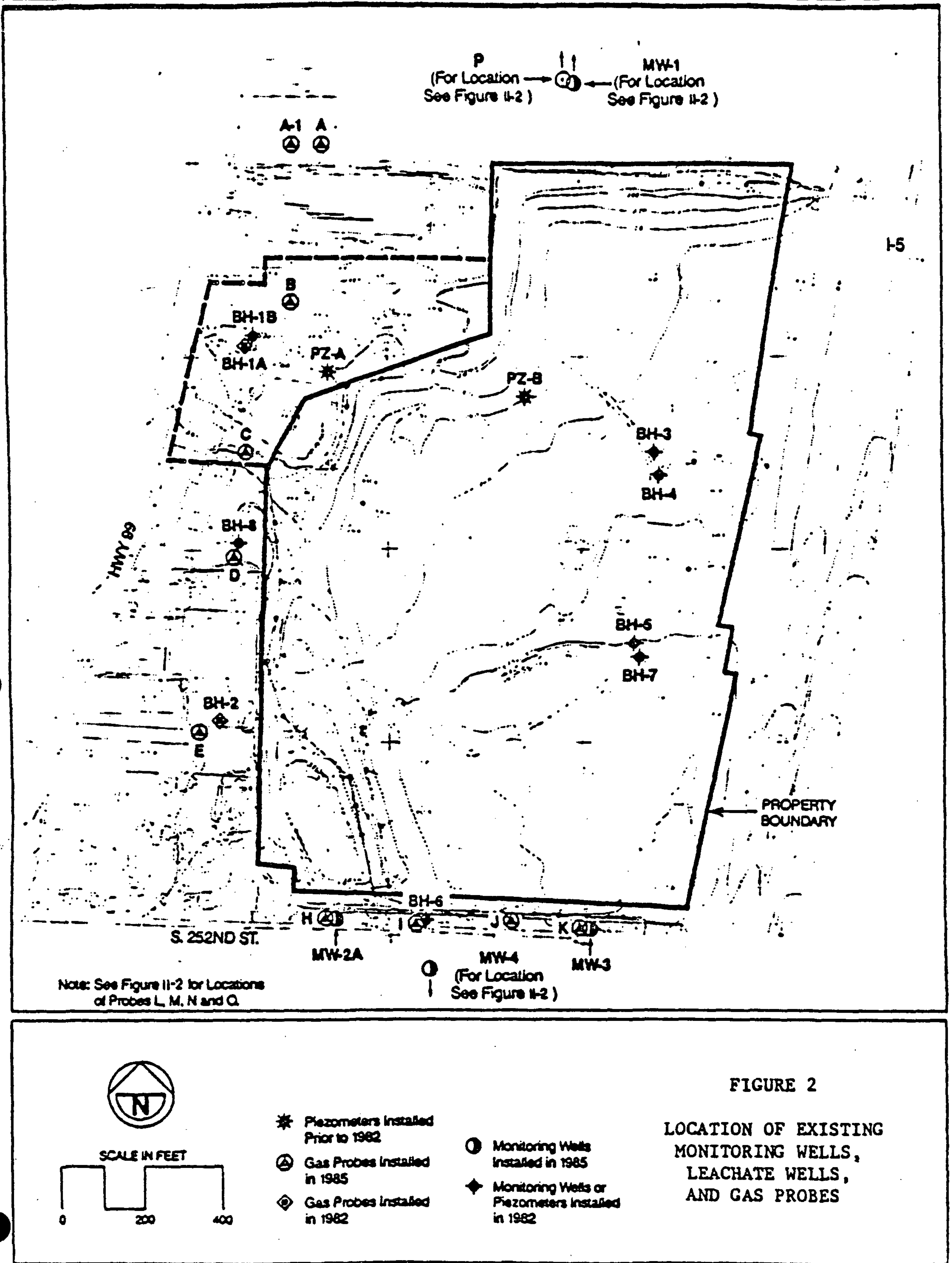


FIGURE 2

LOCATION OF EXISTING MONITORING WELLS, LEACHATE WELLS, AND GAS PROBES

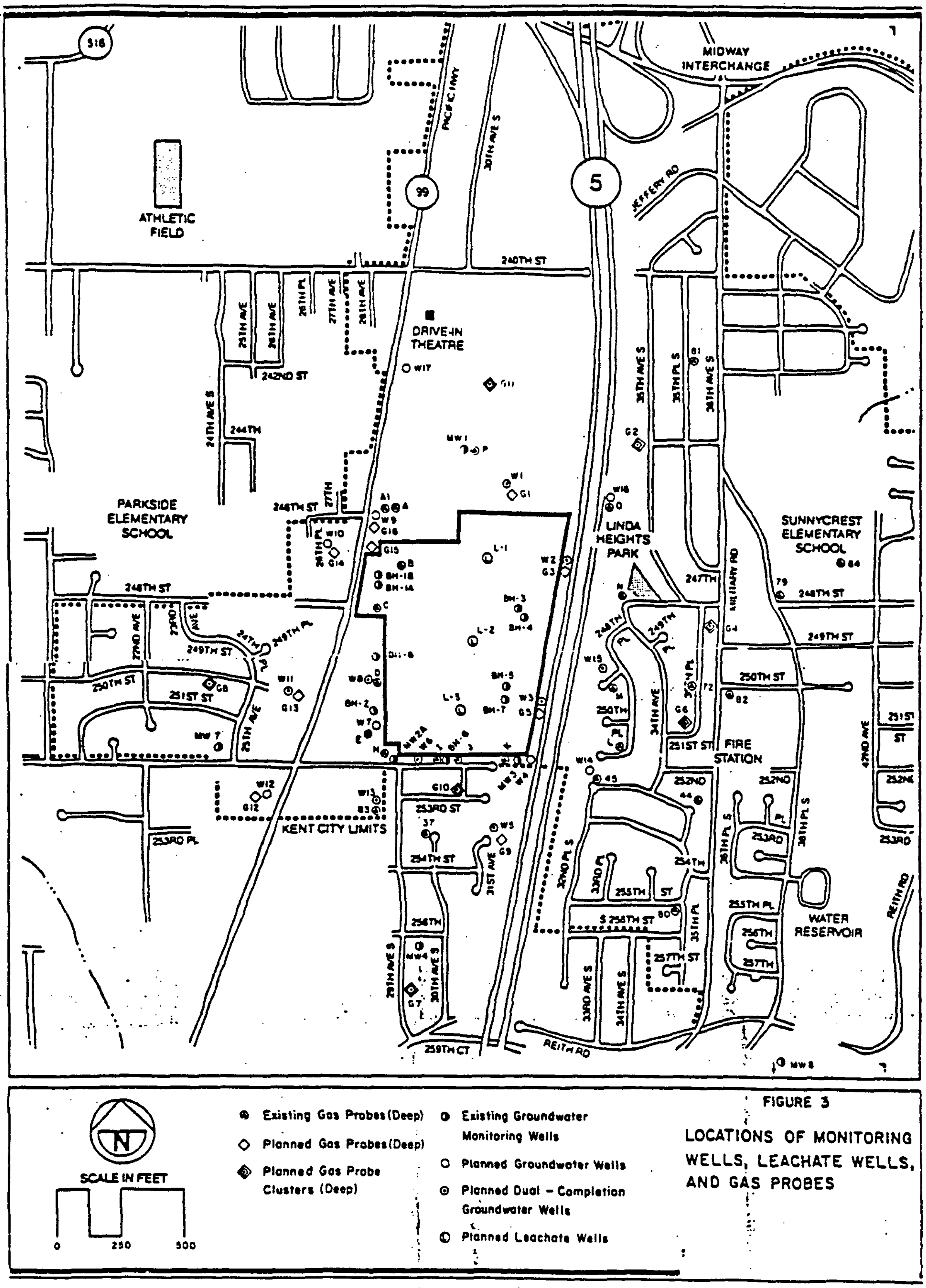
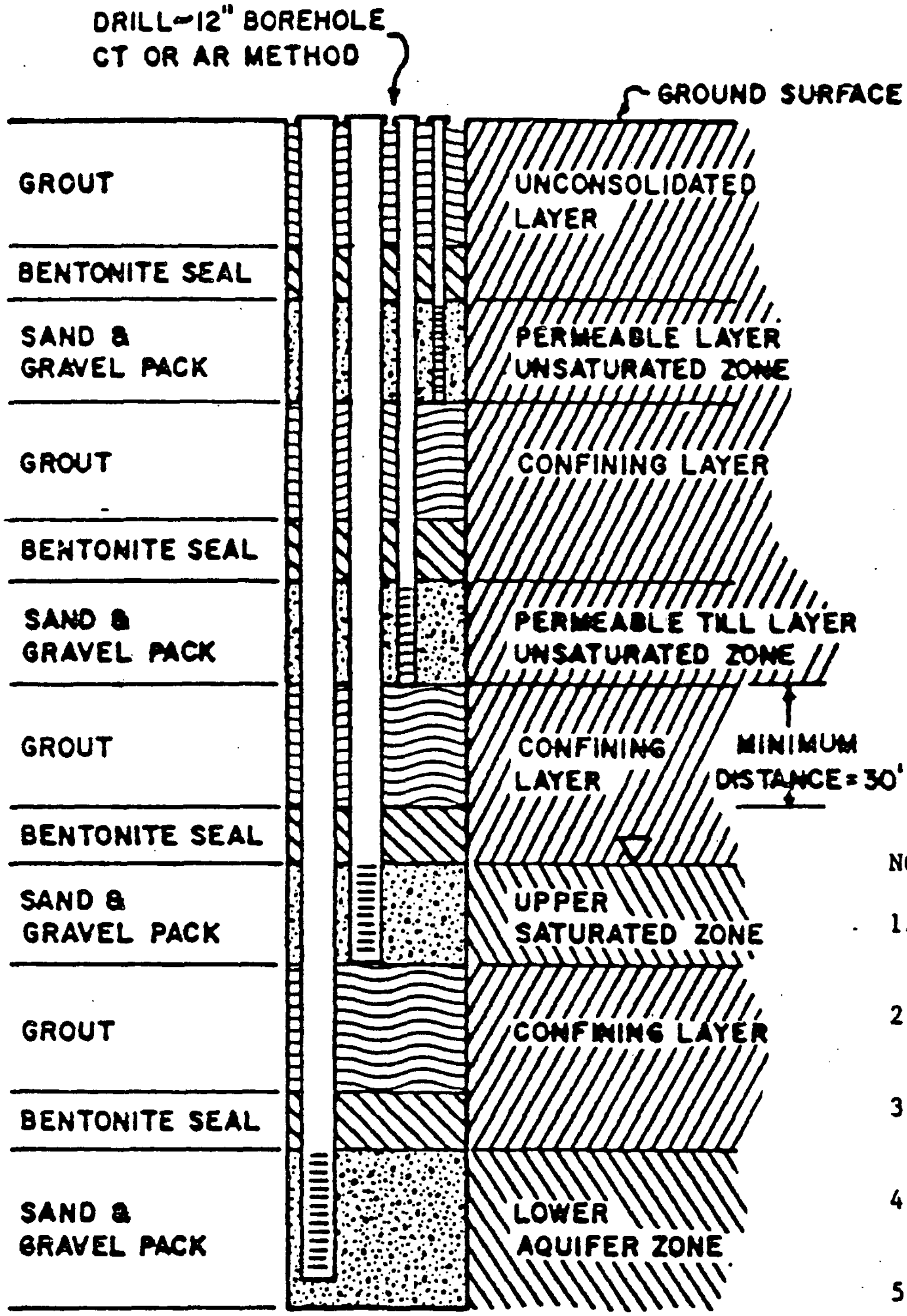


FIGURE 3

LOCATIONS OF MONITORING WELLS, LEACHATE WELLS, AND GAS PROBES



NOTES:

1. BENTONITE SEAL
   MIN. THICKNESS = 24"
2. WELL CASING
   2" ID SCH 80 PVC
3. PROBE CASING
   3/4" ID SCH 80 PVC
4. SCREENS = 0.02" SLOTS
   SCH 80 PVC
5. GROUND FLUSH
   LOCKING MONUMENTS

FIGURE 4

TYPICAL CLUSTERED
WELL/PROBE INSTALLATION
NO SCALE

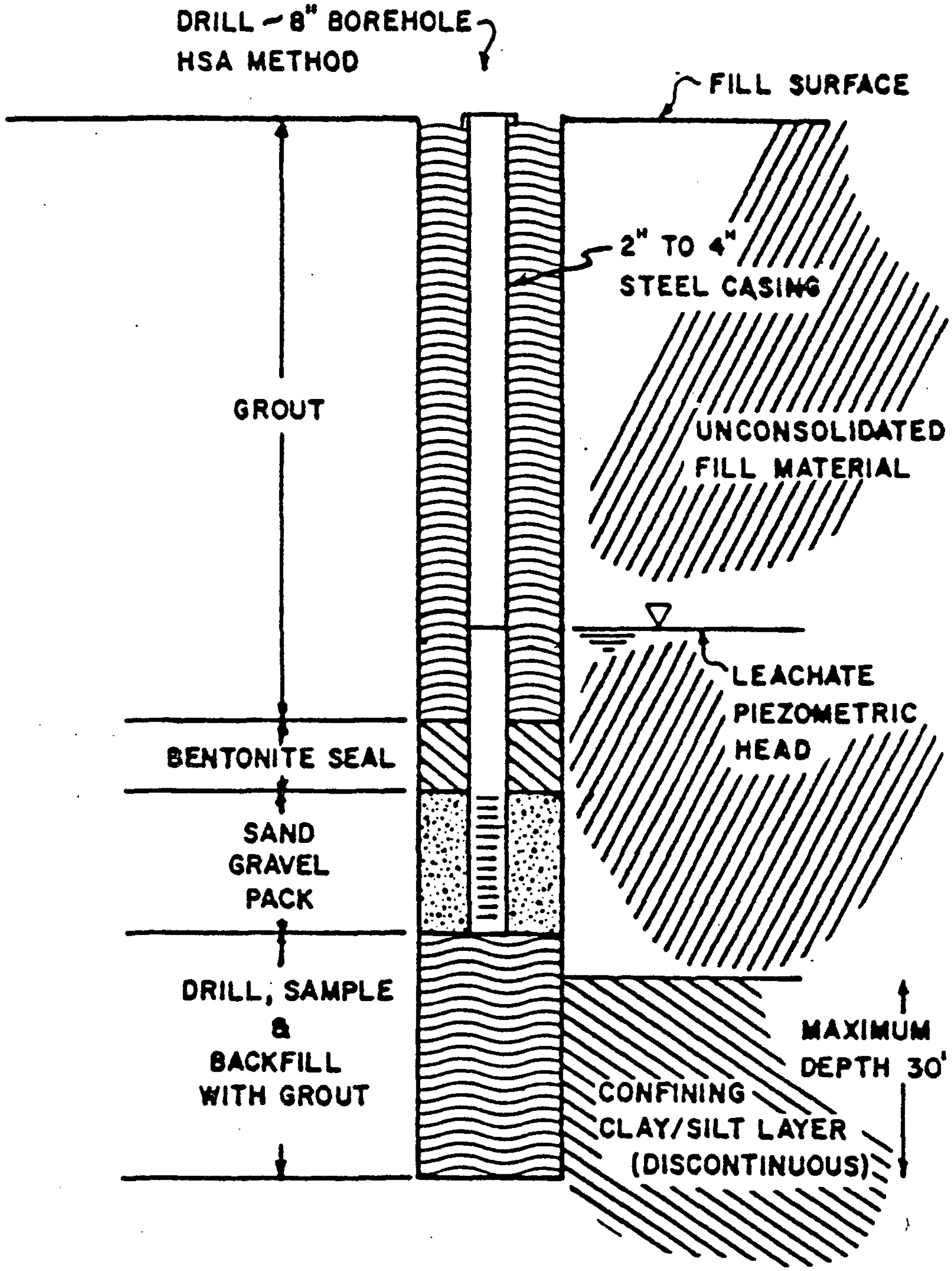
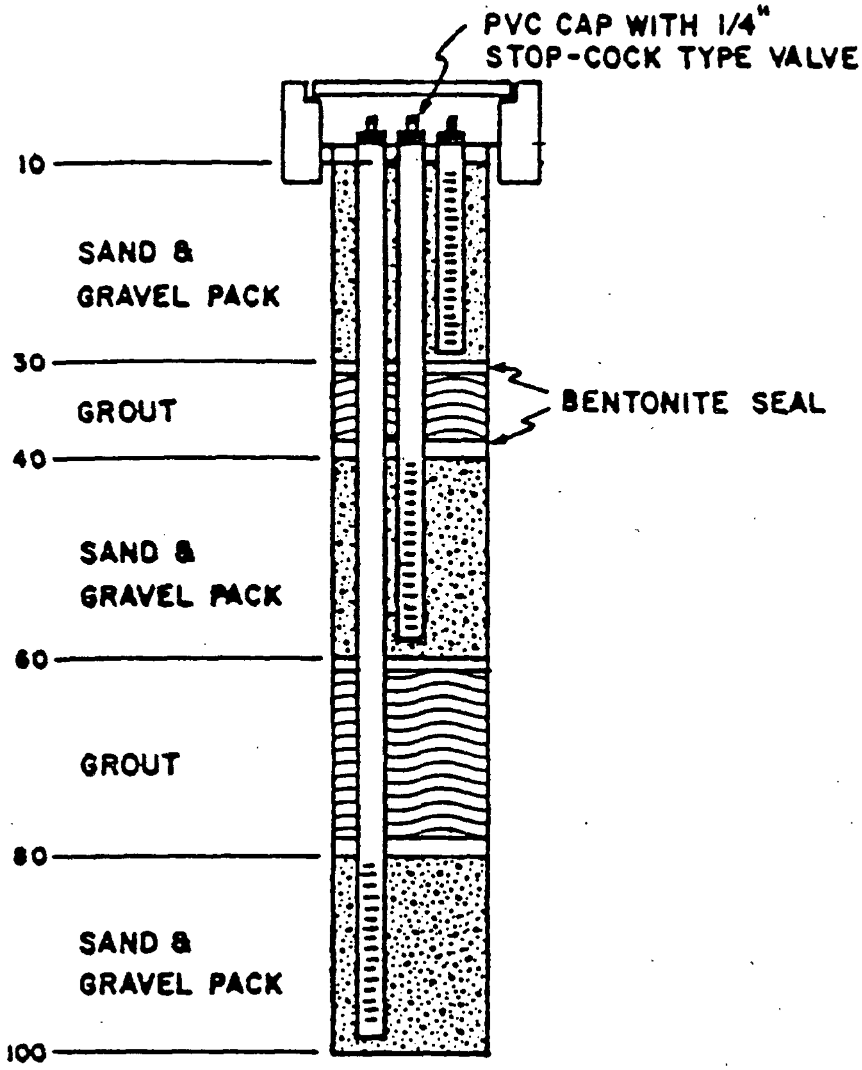


FIGURE 5

TYPICAL LEACHATE WELL INSTALLATION

NO SCALE



NOTES:

ALL PROBES CONSTRUCTED WITH 1/2 TO 3/4 INCH ID SCH 80 THREADED PVC CASING. SCREEN WILL BE THREADED PVC WITH 0.02 INCH SLOTS.

FIGURE 6

INTERMEDIATE DEPTH
GAS PROBE INSTALLATION
NO SCALE

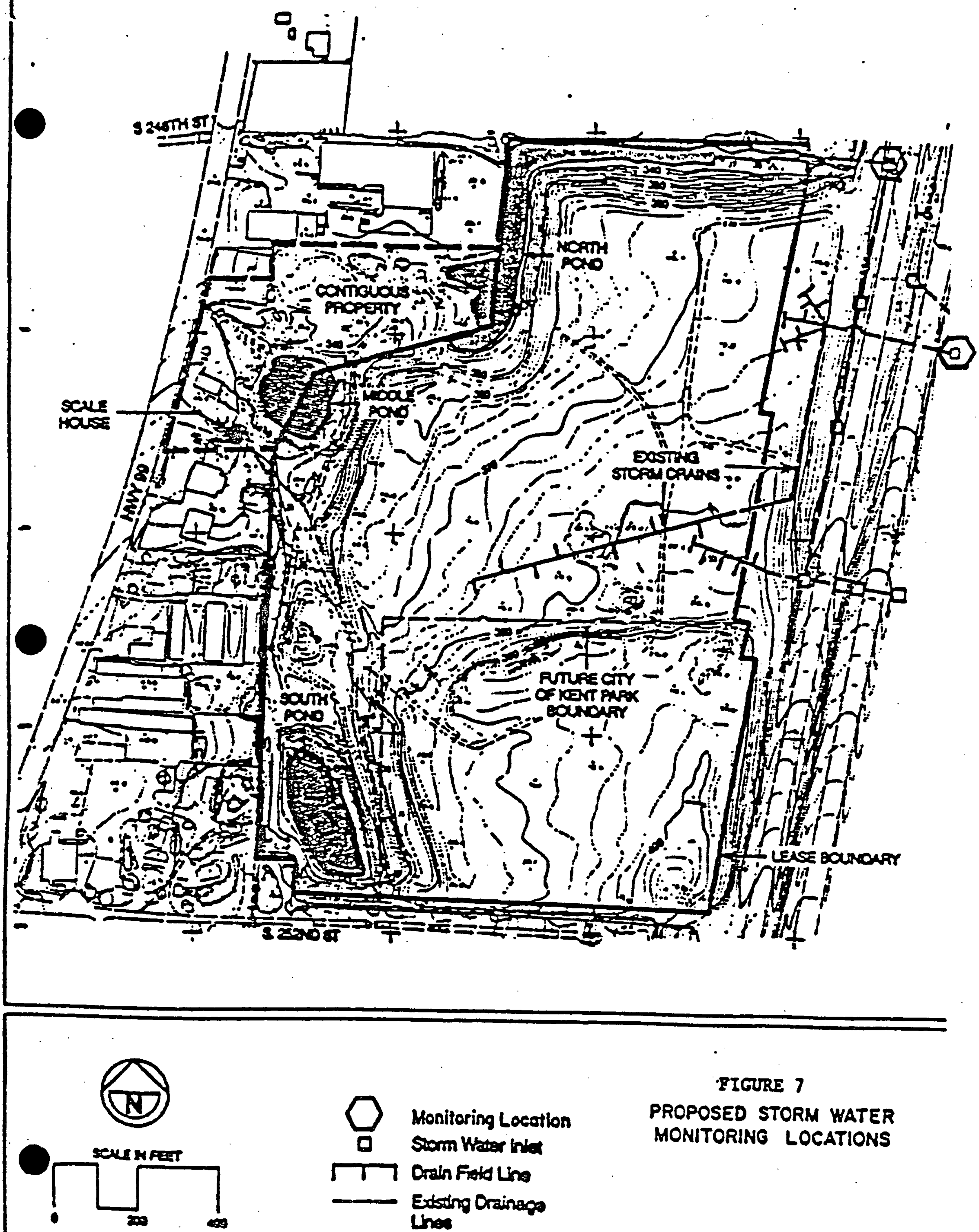


FIGURE 7
PROPOSED STORM WATER MONITORING LOCATIONS

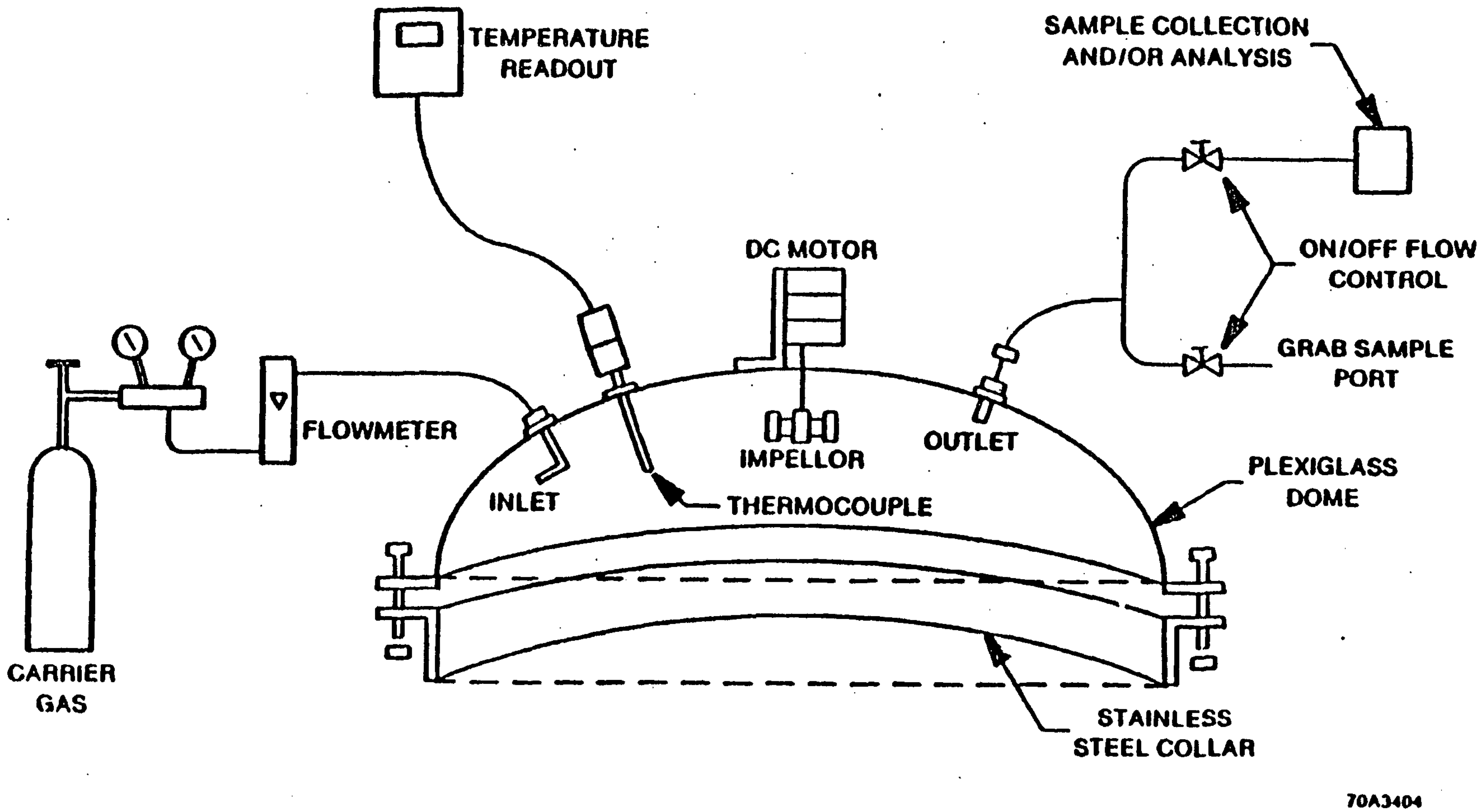


Figure 8 Cutaway Side View of Emission Isolation Flux Chamber and Sampling Apparatus

(form Radian Corporation, 1984)

17.03 APPENDIX C
SAMPLE PRESERVATION
AND PACKAGING

Table of Contents
for
APPENDIX C
Sample Preservation and Packaging

17.03 SAMPLE PRESERVATION AND PACKAGING

17.03.1 Sample Volume and Container Requirements

The volumes recommended for various samples and the recommended container to be used for storage of the sample are detailed in Table C-1. It is highly important that the recommendations be followed.

Table C-1 Volume and Container Requirements for Sample

Organic Sample	Volume	Total Container
Water		
• Extractable	1 gallon	Amber glass jars, 2 80-ounce
• Volatile	80 ml	Glass vials, 2-40 ml
Soil		
• Extractable	8 ounces	Glass jar (wide mouth), 8-ounce
• Volatile	240 ml	Glass vial, 2-120 ml
Inorganic Samples		
Water		
• Metals (Task 1 & 2)	1 liter	Polyethylene bottle 1-liter
Soil		
• All tasks	8 ounces	Glass jar (wide mouth), 8-ounce
High Concentration Samples		
All organic and inorganic tasks	6 ounces	Glass jar (wide mouth), 8-ounce

17.03.2 Specifics on Sample Containerization and Preservation

Sampling procedures are detailed in the following sections for various types of samples. Procedures are broken down as to organic or inorganic samples, type of phase (water, soil, or sediment), and concentration level.

17.03.2.1 Organic Samples.

Water

- Low Concentration

  Two 80-ounce amber glass bottles (Teflon-lined caps); iced to 4 C.

  Two 40-ml glass volatile organic analysis (VOA) vials (duplicates) (teflon-lined caps); iced to 4 C. Special procedures required for VOA sampling (e.g., no headspace) will be followed according to EPA contract lab requirements.

- Medium Concentration

  One 8-ounce (Teflon-lined caps) filled 3/4 full; do not ice.

  Two 120-ml glass vials (Teflon-lined caps) filled completely full (minimize headspace).

- EP Toxicity Extraction

  One 16-ounce (Teflon-lined caps) filled no more than three-fourths full; do not ice.

17.03.2.2 Inorganic Samples.

Water

- Low Concentration

  One 1.0-liter polyethylene bottle (lined cap) for metals analysis; acidify to pH 2 with HNO_3.

  One 1.0-liter high density polyethylene bottle (add 6N NaOH to pH 12, ice to 4 C)

- Medium Concentration

  Same as for low concentration samples.

Soil/Sediment

- Low Concentration

  One 8-ounce glass wide mouth bottle (Teflon-lined cap). Do not ice.

  One 8-ounce wide mouth jar (Teflon cap) 3/4 full. Do not ice.

- Medium Concentration

  One 8-ounce glass wide mouth bottle (Teflon-lined cap) filled 3/4 full. Do not ice.

17.03.2.3 High Concentration (organic and inorganic) Samples.

Water and Soil/Sediment

- One 8-ounce glass wide mouth bottle (Teflon-lined cap) filled more than 3/4 full. Do not ice.

17.03.2.4 Sample Packaging. Sample packaging will be in accordance with procedures in the following manuals:

- "Enforcement Considerations for Evaluations of Uncontrolled H. W. Disposal Sites by Contractors" EPA

- "User's Guide to Contract Laboratory Program" EPA

Each sample package shall be so designed and constructed and its contents so limited, that under conditions normally incident to transportation:

(1) There will be no significant release of materials to the environment.

(2) Inner containers that are breakable must be packaged to prevent breakage and leakage. Completed packages must be capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. Cushioning and absorbent materials must not be capable of reacting with the contents.

17.03.2.5 Sample Shipping. Sample shipping will be in accordance with the following regulations: DOT Reap @ 49CFR171 et seq.

17.03.2.6 <u>Sample Handling</u>. After documentation, samples will be handled as follows:

(1) Seal drain plug in cooler.

(2) Place vermiculite in bottom.

(3) Wrap glass samples with bubble wrap, place in cooler.

(4) Add ice in plastic bags.

(5) Fill remaining space with vermiculite.

(6) Attach chain of custody and traffic documents in plastic bag to inside of cooler lid.

(7) Seal cooler with strapping tape and custody seals.

(8) Label outside of cooler with name/address of receiving laboratory.

(9) Fill out and attach Federal Express airbill to cooler. (Airbill number will be on the traffic documents and chain of custody record.)

(10) Deliver coolers to Federal Express for "Priority one/overnight shipment."

(11) Keep shippers copy of airbill.

(12) Notify SMO that samples were shipped and any other information that is required.

(13) Receive samples next day at laboratory and inform SMO of any problems.

(14) Receive notification from SMO that samples were received.

(15) Maintain file of all documentation with team leader.

17.03.3 Detailed Procedure

17.03.3.1 Low Concentration (Environmental) Samples. Many samples collected during this investigation are expected to contain low concentrations (less than 10 ppm) of organic and inorganic chemical compounds and will, therefore, be considered environmental samples. Procedures for packing low concentration soil and water samples for shipment will be as follows:

(1) Determine maximum weight allowed per package from shipper (70 pounds for Federal Express shipment).

(2) Secure sample bottle lids or plastic caps on brass tubes with strapping tape or evidence tape. At the same time secure string from numbered US EPA sample identification tag around lid or brass tube.

(3) Mark volume level on bottles with grease pencil.

(4) Place about three inches of inert cushioning material, such as; vermiculite or Zonolite, in bottom of cooler.

(5) Labels/Sample Identification Tags. Numbered sample tags must be used on all samples. The organic/inorganic traffic report number labels must appear on the bottles to be sent to CLP laboratories. Cover the labels with clear plastic tape.

(6) Place containers in cooler so that they do not touch.

(7) Put VOA (volatile organic analysis) vials in Ziploc plastic bag and place them in the center of the cooler.

(8) Pack bottles, especially VOA vials, in inert cushioning material.

(9) Fill cooler with inert cushioning material and blue ice, if sample refrigeration is required.

(10) Put paperwork (chain of custody and traffic report copies) in plastic bags and tape with masking tape to inside lid of cooler.

(11) Tape cooler drain shut.

(12) After acceptance by Federal Express or shipper, wrap cooler completely with strapping tape at two locations. Secure lid by taping. Do not cover <u>any</u> labels.

(13) Place laboratory address on top of cooler.

(14) Put "This Side Up" labels on all four sides and "Fragile" labels on at least two sides.

(15) Affix numbered custody seals on front right and back left of cooler. Cover seals with wide, clear tape.

17.03.3.2 <u>Medium Concentration Samples</u>. If medium concentration samples (10 ppm - 15 percent) are collected (as indicated by in-field OVA screening), they will probably fall within the Flammable Liquids or ORM-A Hazard class per DOT shipping regulations. The following packing and labeling procedures will be followed:

(1) Secure sample jar lids or plastic caps on brass tubes with strapping tape or evidence tape. At the same time secure string from US EPA numbered sample identification tag around sample container.

(2) Position jars and tags in Ziploc plastic bag so that the tag may be read.

(3) Place about 1/2 inch of cushioning material (such as vermiculite or Zonolite) in the bottom of a metal can (such as a paint can).

(4) Place jar in can and fill remaining volume of can with cushioning material.

(5) Close the can using three clips to secure the lid.

(6) Write traffic number on can lid. Indicate "This Side Up" by drawing an arrow and place the correct DOT Hazard class label on the can. Do not overlap labels.

(7) Place about 1 inch of packing material in bottom of cooler.

(8) Place cans or brass tubes in cooler and fill remaining volume of cooler with packing material.

(9) Put paperwork in plastic bags and tape with masking tape to inside lid of cooler.

(10) Tape cooler drain shut.

(11) After acceptance by Federal Express or shipper, tape cooler completely around with strapping tape at two locations. Secure lid by taping. Do not cover any labels.

(12) Place lab address on top of cooler.

(13) Put "This Side Up" labels on all four sides and DOT Hazard class label on at least two sides.

(14) Note: Write DOT Hazard class on wide tape and place on cooler if this is not marked on the margin of your DOT label.

(15) "Danger-Peligro" (Cargo Aircraft Only) labels should be placed on at least two sides of the cooler.

(16) Affix numbered custody seals on front right and back left of cooler. Cover seals with wide, clear tape.

17.03.3.3 High Concentration Samples.

17.03.3.3.1 Eight-Ounce Amber or Opaque Glass Jar. Jar shall be filled with sample portion, sealed with Teflon-lined cap or lid, and the outside thoroughly washed and rinsed. Label pint jar with the following information:

- EPA Region X Sample Tag.
- EPA Sample Management Office (SMO) Contract Sample Tag.
- EPA Region X Custody Seal.

Place pint jars inside small plastic bag and close with fiber tape. (ALWAYS DOUBLE CHECK LIDS FOR TIGHT FIT!)

17.03.3.3.2 Paint Can. Place 8-ounce jar wrapped in plastic bag inside paint can filled with vermiculite contained in a second plastic bag. Seal paint can with clips. Label paint can with the following information:

- EPA Region X Sample Tag.
- SMO Contract Sample Tag.
- "Flammable Solid" or "Flammable Liquid" Label.
- "Flammable Solid" or "Flammable Liquid" N.O.S.
- "Cargo Aircraft Only" Label.
- Laboratory Address (lid).
- EPA Region X Custody Seals on opposing sides of the paint can lid.

17.03.3.3.3 Ice Cooler. Place large plastic bag (30-gallon) inside cooler, pour layer of vermiculite into plastic bag, place paint cans inside plastic bag, and pour layer of vermiculite over paint cans. Be sure paint cans fit snugly enough to eliminate movement during shipment. Seal plastic bag with fiberglass tape. Place an EPA Region X Custody Seal under the last wrap of tape.

17.04 APPENDIX D

ANALYTICAL PARAMETERS

TABLE OF CONTENTS

17.04 ANALYTICAL PARAMETERS

17.04.1 General

Preservation and containment of samples will be in accordance with standard operating procedures as outlined in Section 5.4 "Sample Containers and Preservation" and Appendices B and N, Sampling Plans. Since the materials disposed at the site have not been completely identified, a complete standard chemical analysis will be run on all samples submitted to the Contract Lab Program (CLP) except as indicated in Section 5.07. These chemical parameters include:

- Extractable organics
- Volatile organics
- Inorganics

Types of samples to be taken and parameters to be measured on each sample type are discussed in the following sections. The expected range of the parameter is given when known.

17.04.2 Air Monitoring

Parameters recorded by portable meteorological station are:

- Wind speed
- Wind direction
- Air temperature

Barometric pressures and relative humidity can be obtained from the nearest National Weather Service reporting station.

17.04.3 Gas Samples

17.04.3.1 Analyzed in Field. Parameter to be measured and expected ranges are:

• Hydrogen Sulfide	0-20 ppm
• Combustible gas	0-200% of LEL
• Oxygen	18-20.5%
• Organic vapors	(see Table 2-1)

17.04.3.2 Analyzed in Laboratory. Parameters to be measured and expected ranges are:

- Hydrogen Sulfide 0-20 ppm
- Combustible gas 0-200% of LEL
- Organic vapors (see Table Z-1)

17.04.4 Surface Water

17.04.4.1 Parameters Measured in Field. Many parameters to be measured for surface water are easily measured in the field. Of critical importance are:

- Rate of water and source flow onto cite
- Rate of flow and destination from site
- pH
- Temperature
- Conductivity
- Redox potential

17.04.4.2 Parameters Measured in Laboratory. Surface water samples submitted to laboratory are to be analyzed for:

- Priority Pollutant Metals
- Priority Pollutant Organics (see Table Z-1)
- Total Dissolved Solide
- Total Organic Carbon
- Major ions - Bicarbonate, Calcium, Carbonate, Chloride, Fluoride, Iron, Magnesium, Potassium, Sodium, sulfate, sulfide
- Nitrogen - Ammonia, Nitrate
- Hardness
- Alkalinity
- Biological oxygen demand
- Acid neutrals
- Acid extractables
- Base neutrals
- Pesticides

17.04.5 Ground Water and Leachate

17.04.5.1 Parameters Analyzed in Field. Parameters for ground water and leachate tube measured in the field are:

- Water level

- pH
- Temperature
- Conductivity
- Redox potential

17.04.5.2 Parameters Analyzed in Laboratory. Parameters to be measured for ground water and leachate in the laboratory are the same as for surface water.

17.04.6 Soils

17.04.6.1 Near Surface Soil. In situ permeability will be determined along with density and moisture content.

17.04.6.2 Subsurface Soil. Parameters to be measured are:

- Permeability
- Grain size
- Material compatibility
- Soil Classification
- Priority Pollutant Metals
- Priority Pollutant Organics

Since the RI is to evaluate the potential hazard associated with foreign materials disposed in the landfill, additional parameters to be measured are:

- Volatiles
- Pesticide
- PCBs
- Neutrals
- Acids/Bases
- Trace Metals (see Table 4-1)
- Total organic carbon
- Total sulfide
- Total solids

17.04.6.3 Terminal 5 Sediments. Parameters to be measured on the sediments were selected to determine if any pollutants were carried into the landfill with the sediment and if they pose a current hazard. Parameters to be measured are the same as for subsurface soil.

17.05 APPENDIX E

EQUIPMENT CALIBRATION AND OPERATION

17.05 EQUIPMENT CALIBRATION AND OPERATION

Manuals for calibration and operation of equipment to be used in the field for waste characterization and sampling are referenced in this Appendix. Copies of the manuals will be available in the field for reference when needed.

(1) Foxboro OVA128 Organic Vapor Analyzer (GC/FID).

(2) HNu Organic Vapor Analyzer (PID).

(3) MSA 361 Combustible Gas/Oxygen/H_2S Analyzer.

(4) MSA 260 Combustible Gas/Oxygen Analyzer.

(5) MSA 60 Combustible Gas Analyzer (% by Volume).

(6) MSA Mini H_2S Analyzer.

(7) Bacharach CO_2 Analyzer.

(8) Bacharach TLV Analyzer.

(9) MSA Calibration Check Kit, Model R, Propane-in-Air.

(10) MSA Calibration Check Kit, Model R, 10 ppm H_2S in Nitrogen.

(11) Foxboro CENTURY Programmed Thermal Desorber (PTD).

(12) Water Level Indicator
Soiltest, Inc., Model DR-760A

(13) Mini Conductivity Meter Hack Model 17250. Manufacturer's instructions dated 9/20/80.

(14) Digital pH Meter, Orion Research Model 201 "Instruction Manual."

(15) Thermometer, Standard Laboratory Thermometer.

(16) Draeger Tube Kit, Model 31. "Multi Gas Detector; Instructions For Use," April 1978 and "Detection Tube Handbook," May 1983.

(17) Monitor 4 Radiation Meter "Radiation Alert Monitor 4 Operation Manual," 1982.

Field instruments to be used for this investigation will be checked for defects and calibrated prior to use in the field. The pH meter is checked against standard buffer solutions before and after each use. Other instruments are field checked and zeroed as per manufacturer's specifications prior to use. Field calibration documents are recorded in the field log books.

Calibration procedures for each portable gas analyzer listed above are included below for reference.

Foxboro OVA 128 Organic Vapor Analyzer (GC/FID)

The OVA 128 used in the Midway Landfill gas investigation is equipped with a gas chromatograph strip chart recorder, a tri-column chromatographic column using three separate media for compound separations, and a portable isothermal pack for conducting isothermal chromatographic analysis at 0 or 40 degrees Centrigrade. The OVA 128 is factory calibrated to a methane in air standard. Recalibration will be performed every six to nine months. Daily zeroing of the instrument is performed each day before initiating any use of the instrument. The instrument is zeroed in the following manner:

1. Instrument is turned on and hydrogen flame ignited.
2. Probe is connected to a carbon absorption unit via ployethylene tubing.
3. Instrument readout is placed on the X1 scale.
4. With "fresh" air supply being drawn into the instrument, adjustment pot is manipulated until zero (0) readout is obtained.

For quantitative analysis of a specific organic compound other than methane, the OVA must be calibrated for the compound of interest. This is accomplished using a standard gas mixture for the specific compound of interest. After the instrument has been "zeroed", a sample of the gas standard is drawn into the instrument. The gas select knob on the panel is then used to adjust the readout meter indiction to correspond to the calibration gas concentration.

HNu Organic Vapor Analyzer (GC/FID)

1. Instrument placed in standby mode and allowed to warm up for 5 minutes.
2. Instrument zeroed using instrument pot.
3. Instrument switched to 0-200 ppm range.
4. Calibration gas tank (HNu 63 ppm organics) attached to 11.7 ev probe via control valve/surgical hose.
5. Valve opened, instrument reading allowed to stabilize.
6. Span Control adjusted to obtain 63 ppm readout.

7. Span control locked into position and span setting noted.
8. Instrument placed in standby mode.

MSA-361 Combustible Gas/Oxygen/H_2S Analyzer

1. Flow control valve attached to calibration gas tank (.75% pentane).
2. Adaptor hose fitted to valve.
3. Flow control valve opened.
4. Adaptor hose fitted to inlet of instrument and instrument reading allowed to stabilze.
5. If LEL meter does not read between 47% and 55%, LEL span control inside instrument adjusted to obtain 50%.
6. Oxygen verified to read approximately 20.8% in fresh air.
7. Flow control valve attached to calibration gas tank (10 ppm Hydrogen Sulfide in Nitrogen carrier gas).
8. Repeat step 3.
9. Repeat step 4.
10. Tox readout allowed to stablize.
11. Tox span control adjusted (inside instrument) to obtain 10 ppm.

MSA-260 Combustible Gas/Oxygen Analyzer

1. Steps 1-6 (MSA-361) repeated.

MSA-60 Combustible Gas Analyzer (% by Volume)

1. Instrument turned on and allowed to warm up.
2. Scale placed on 0-5 setting and zeroed.
3. The span setting is adjusted using 0.75% pentane in air calibration gas to read approximately 1.5% combustible gas.

   To be properly calibrated, 2% methane and 100% methane should be used as calibration standards. This gas was unavailable during the first two rounds of sampling. During the first round, the instrument was not calibrated at all. During the second round of sampling, 0.75% pentane was used to calibrate the instrument. In addition, an arbitrary setting of 1.5% was chosen to adjust the instrument reading. The purpose was to get response curves and adjust data later, but at least have pentane response noted. As it turns out, no response curves have been published for this instrument. However, an MSA Representative in Pittsburgh, PA determined that 0.75% pentane should yield about 1.5% on the meter (or approximately twice as much as the same concentration of methane would). Therefore second round combustible gas readings are much more "reliable" than the first round.

MSA Mini H_2S Analyzer

1. Steps 7-11 (MSA-361) repeated.

Bacharach CO_2 Analyzer

The following procedures outline requirments for operating the Bacharach CO_2 Analyzer.

1. Purge sample line by aspirating bulb 6 times.
2. Press sampling valve on top of meter to clear instrument and of gas.
3. Adjust scale to read 0% CO_2 by volume at the tope of the minus.
4. Attach adapter to probe and instert CO_2 sampling probe into adapter.
5. Open valve.
6. Attach sample line to sampling valve and hold in place with palm of hand.
7. Aspirate bulb eighteen (18) times.
8. Remove sample line from instrument.
9. Invert meter and allow to stabilize.
10. Invert meter to upright position and allow to stabilize again.
11. Record valve as observed at top of minus.
12. Press sample valve to clear instrument of gas.

BACHARACH TLV ANALYZER

Calibration

1. After recharging overnight, check charge on instrument.
2. Allow to warm up for ten (10) minutes (if no drift is observed when switching scales on instrument, proceed as follows).

3. Place instrument on x10 scale and zero.
4. Remove casing.
5. Attach calibration gas tank (500ppm methane) to instrument.
6. Open valve of tank and adjust so flowmeter reads (2).
7. Adjust x10 potentiometer so instrument reads 500 (50 on x10 scale).
8. Disconnect calibration gas and allow instrument to return to zero.
9. Change scale to x100.
10. Adjust zero so instrument reads 10.
11 Change scale to x10 and adjust potentiometer to read 100.
12. Adjust to zero and allow to run for 1 minute.
13. Adjust zero so instrument reads 10.
14. Change scale to x1.
15. Adjust x1 potentiometer so instrument reads 100.
16. Adjust to zero.
17. Change scale from x1-x10-x100.
18. If no drift observed, instrument properly calibrated.

<u>Normal Use</u>

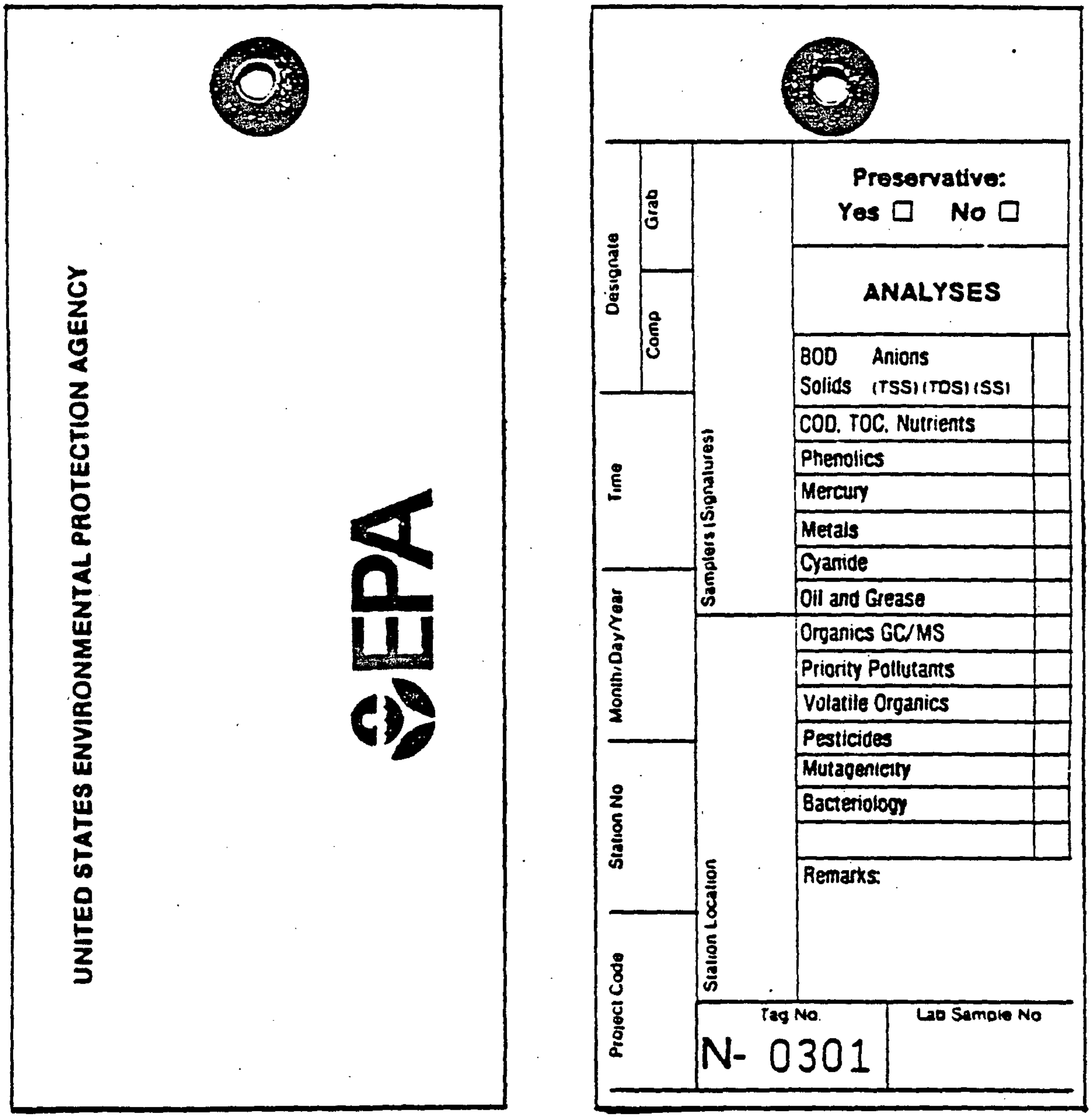
1. Instrument fully charged and allowed to warm for 10 minutes.
2. Attach adapter to probe.
3. Zero instrument
4. Insert probe into adapter while opening valve.
5. Allow instrument to stabilize and record reading.
6. Shut valve while removing probe from adapter.

Specific quality assurance procedures are outlined in the Quality Assurance (QA) Plan and the Quality Assurance Project Plan (QAPP).

17.06 APPENDIX F

STANDARD FORMS TO BE USED

Table of Contents
for
APPENDIX F
Standard Forms to be Used



Back Side

Front Side

Figure F-1 SAMPLE IDENTIFICATION TAG Example

50881-1

☆ GPO 878-182

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

N 3471

PROJ. NO.	PROJECT NAME						
SAMPLERS: (Signature)						NO. OF CON-TAINERS	REMARKS
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION		

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Figure F-2 CHAIN OF CUSTODY RECORD Example

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO.	DATE
SIGNATURE	
PRINT NAME AND TITLE *(Inspector, Analyst or Technician)*	

SEAL BROKEN BY

DATE

EPA FORM 7500-2 (R7-78)

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO.	DATE
SIGNATURE	
PRINT NAME AND TITLE *(Inspector, Analyst or Technician)*	

SEAL BROKEN BY

DATE

EPA FORM 7500-2 (R7-78)

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO.	DATE
SIGNATURE	
PRINT NAME AND TITLE *(Inspector, Analyst or Technician)*	

SEAL BROKEN BY

DATE

EPA FORM 7500-2 (R7-78)

Figure F-3 CUSTODY SEAL Examples

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

RECEIPT FOR SAMPLES

PROJ NO. / PROJECT NAME	Name of Facility
SAMPLERS: (Signature)	Facility Location
Split Samples Offered ( ) Accepted ( ) Declined	

STA NO	DATE	TIME	COMP	GRAB	SPLIT SAMPLES	TAG NUMBERS	STATION DESCRIPTION	NO OF CON-TAINERS	REMARKS

Transferred by: (Signature)	Received by: (Signature) Telephone
Date Time	Title Date Time

Distribution: Original to Coordinator Field Files; Copy to Facility

N 349

Figure F-4 RECEIPT FOR SAMPLES Example

U.S. ENVIRONMENTAL PROTECTION AGENCY CLP Sample Management Office

HIGH HAZARD TRAFFIC REPORT

Sample Number: F 5148

FIELD SAMPLE RECORD

① Case Number: ______

Sample Site Name/Code: ______

② Field Sample Description:

- _ Drum
- _ Aqueous Liquid
- _ Sludge
- _ Solid
- _ Oil
- _ Other ______

③ Ship To:

Attn:

④ Sampling Office: ______

Sampling Personnel: ______

(name)

______

(phone)

Sampling Date: ______

(begin) (end)

⑤ Known or Suspected Hazards: ______

⑥ Sample Location:

⑦ Preparations Requested: (check below)

Sample Volume: ______

- _ Organics
- _ Volatile Organics
- _ Base/Neutral Acid TCDD
- _ Pesticides, PCB
- _ Inorganics
- _ Total Metals
- _ Total Mercury
- _ Strong Acid Anions

F 5148

F 5148

F 5148

F 5148

F 5148

⑧ Shipping Information: ______

(name of carrier)

______

(date shipped)

______

(serial number)

⑨ Special Handling Instructions:

SMO Copy

Figure F-5 HIGH HAZARD TRAFFIC REPORT Example

U.S. ENVIRONMENTAL PROTECTION AGENCY (HW) Sample Management Office
P.O. Box 818 Alexandria, VA 22313 - 703/557-2490 FTS 557-2490

INORGANICS TRAFFIC REPORT

Sample Number
MF 1700

(1) Case Number: ____________
Sample Site Name/Code:
____
____
____

(2) SAMPLE CONCENTRATION
(Check One)
____ Low Concentration
____ Medium Concentration

(3) SAMPLE MATRIX
(Check One)
____ Water
____ Soil/Sediment

(4) Ship To:

Attn:

Transfer
Ship To:

(5) Sampling Office: ____________
Sampling Personnel:
(Name) ____________
(Phone) ____________
Sampling Date:
(Begin) ________ (End) ________

(6) Shipping Information:
Name Of Carrier:
____
Date Shipped: ____________
Airbill Number: ____________

(7) Sample Description:
(Check One)
____ Surface Water
____ Ground Water
____ Leachate
____ Mixed Media
____ Solids
____ Other ____________
(specify)
MATCHES ORGANIC SAMPLE NO. ______

(8) Mark Volume Level
On Sample Bottle
Check Analysis required
___ Task 1 & 2
___ Task 3 Ammonia
Sulfide
Cyanide

SMO COPY

MF 1700 - Task 1 & 2
MF 1700 - Task 1 & 2
MF 1700 - Task 3
MF 1700 - Task 3
MF 1700 - Task 3
MF 1700 - Task 3
MF 1700 - Task 3

Figure F-6 INORGANICS TRAFFIC REPORT Example

U.S. ENVIRONMENTAL PROTECTION AGENCY [illegible]
P.O. Box [illegible]

ORGANICS TRAFFIC REPORT

Sample Number
FA 101

① Case Number:

Sample Site Name/Code:

② SAMPLE CONCENTRATION
(Check One)

___ Low Concentration
___ Medium Concentration

③ SAMPLE MATRIX
(Check One)

___ Water
___ Soil/Sediment

④ Ship To:

Attn:

Transfer
Ship To:

⑤ Regional Office: ______
Sampling Personnel:

(Name)

(Phone)

Sampling Date:

(Begin) (End)

⑥ For each sample collected specify numb[er] of containers used and mark volume lev[el] on each bottle.

	Number of Containers	Approxi[mate] Total Vo[lume]
Water (Extractable)		
Water (VOA)		
Soil/Sediment		
Water (Ext/VOA)		
Other		

FA 101	• Water (Extractable)
FA 101	• Water (Extractable)
FA 101	• Water (Extractable)
FA 101	• Water (Extractable)
FA 101	• Water (VOA)
FA 101	• Water (VOA)
FA 101	• Soil/Sediment (Ext & VOA)
FA 101	• Soil/Sediment (Ext & VOA)
FA 101	• Water (Ext & VOA)
FA 101	• Water (Ext & VOA)

⑦ Shipping Information

Name of Carrier

Date Shipped:

Airbill Number:

⑧ Sample Description

___ Surface Water ___ Mixed Media
___ Ground Water ___ Solids
___ Leachate ___ Other (specify) ______

⑨ Samp[le]

⑩ Special Handling Instructions:
(e.g., safety precautions, hazardous nature)

SMO COPY

Figure F-7 ORGANICS TRAFFIC REPORT Example

PACKING LIST

Project: ______	Sampling Date(s): ______	Ship To:	For Lab Use Only
Sampling Contact: ______ (name) ______ (phone)	Date Shipped: ______		Date Samples Rec'd: ______
	Task Name/Code: ______	Attn:	Received By: ______

Sample Numbers	Sample Description (Analysis/Matrix/Concentration/Preservative)
1. ______	______
2. ______	______
3. ______	______
4. ______	______
5. ______	______
6. ______	______
7. ______	______
8. ______	______
9. ______	______
10. ______	______
11. ______	______
12. ______	______
13. ______	______
14. ______	______
15. ______	______
16. ______	______
17. ______	______
18. ______	______
19. ______	______
20. ______	______

Figure F-8 PACKING LIST

PAGE OF
!ST
2-22-83

\- STATION IDENTIFICATION

Parameters in upper case letters must be filled out.

Object Id: _ _ - _______ -_ -_ _- _ _ _   Pipe/trib: _ _

SURVEY#: _ _ _ _ _ (number)   STATION#: _ _

Comment: ____

SPC Zone: _ (N/S) East: _ _ _ _ _ _ _ North: _ _ _ _ _ _ (ft) (start)

SPC Zone: _ (N/S) East: _ _ _ _ _ _ North: _ _ _ _ _ _ (ft) (end)

Water Depth: _ _ _ _ _ (ft)   Tidal Zone: _ (S=sub,I=inter)
(or Land Elevation)

Position: _ _ _ _ _ _ (ft)   Bank: _ (R/L/C)   Distance: _ _ _ _ _ _(ft)
(along line)   (from line)

LOCATION: ____

DATE OCCUPIED	TIME START	TIME END	SAMPLES TAKEN (LIST SAMPLE NUMBERS)

OBSERVER: ______________________ ORG.CODE _ _ _ _   DATE: _ _/_ _/_ _

SIGNATURE: ______________________

Figure 7-9 STATION IDENTIFICATION FORM

PAGE OF

SAMPLE LOG

Parameters in upper case must be filled out. 2-22-85

OBJECT ID: _-_____-_-__-__

SURVEY: __________ (number) STATION#: __ __

DATE: __/__/__ (mm/dd/yy)

TIME(start): __:__ (hh:mm) Time(end) __:__ (end) (hh:mm)

SAMPLE#: __ __ __ WDOE Number: __ __ __ __ __

SAMPLE OF: ______________________________

GEAR TYPE AND SIZE: ______________________________

Water Depth: __ __ __.__ __ (m)

UPPER DEPTH: __ __ __.__ __ (m) LOWER DEPTH: __ __ __.__ __ (m)

Sample Vol: __ __.__ (l) Sample Area: __ __.__ __ (sq m)

Separation (method): ______________________________

Composition (method): ______________________________

SUBSAMPLE NUMBER	# OF CONTAINERS	SAMPLE NUMBER	DESTINATION (and comments)

OBSERVER: ____________________ ORG.CODE __ __ __ __ DATE: __/__/__

SIGNATURE: ____________________

Figure F-10 SAMPLE LOG FORM

Figure F-11 SAMPLE TRACKING MATRIX

SAMPLE TRACKING MATRIX | **SAMPLE TYPE:** | **SITE:** **P.N.:**

SAMPLE I.D. NUMBER	SAMPLE LOCATION	DATE	TIME	SAMPLERS	PHOTO	pH	COND.	TEMP °C	I.T.R. NO.	O.T.R. NO.	C.O.C. NO.	TAG. NO.	AIRBILL NO.	SHIP. DATE	Q.C. LOT NO.

Remarks:

State of Washington Department of Ecology

REQUEST FOR ANALYSIS

DATE __________

SOURCE __________ (Plant, Street, Stream, Study) LAB NOs ____ ____ - ____

LOCATION __________ (City) (County) REQUESTED BY __________

DATES: SAMPLING: __________ TO LAB: __________ COLLECTED BY __________

REPORT DATA TO: __________ LAB APPROVAL BY __________

SPECIAL INFORMATION: PROGRAM CODE _____ ☐ EMERGENCY ☐ CHAIN OF CUSTODY ☐ CLASS II INSPECTION

OTHER __________

MATRIX: ☐ WATER ☐ SOIL ☐ SLUDGE ☐ OTHER (describe)

	ANALYSIS REQUESTED	NUMBER OF SAMPLES	COMPLETED BY	COMPLETED DATE		ANALYSIS REQUESTED	NUMBER OF SAMPLES	COMPLETED BY	COMPLETED DATE
	PHYSICAL					CHEMICAL ORGANIC			
	pH					Chemical Oxygen Demand			
	Turbidity					Oil and Grease, Recoverable			
	Conductivity					Phenolics, Recoverable			
	Salinity								
	Solids %								
	TS								
	TNVS								
	TSS								
	TNVSS					TOXIC POLLUTANTS			
						Primary Pollutants			
						Acid, Base, Neutral Comp.			
	CHEMICAL, INORGANIC					Volatile Organics (VOA)			
	Acidity					Pesticides			
	Alkalinity					Polychlorinated Biphenyls			
	Chloride					Purgeable Chlorinated HC			
	Cyanide, Total					Metals			
	Cyanide, "Free"								
	Fluoride, Total					Ignitability			
	Fluoride, Soluble					EP Toxicity, Metals			
	Hardness, Total					EP Toxicity, Organics			
	Hardness, Calcium					Halogenated Hydrocarbons (HW)			
	Nutrient (8)					Polynuclear Aromatics (HW)			
	Ammonia-N								
	Nitrate-N								
	Nitrite-N								
	Phosphorous, Total					MICROBIOLOGY			
	Phosphate, Ortho					Fecal Coliform Bacteria			
	Sulfate					Total Coliform Bacteria			
						Biochemical Oxygen Demand			
	Metals(6), Cu, Ni, Cr, Pb, Zn, Cd								
	Total								
	Dissolved					BIOLOGY			
	Metals, Other:					Fish Bioassay			
						Lipids, %			

Figure F-12 REQUEST FOR ANALYSIS

SAMPLING ALTERATION CHECKLIST

Sample Program Identification: ____________________

Material to be Sampled: ____________________

Measurement Parameter: ____________________

Standard Procedure for Analysis: ____________________

____

Reference: ____________________

____

____

Variation from Standard Procedure: ____________________

____

____

____

____

____

Reason for Variation: ____________________

____

____

____

Resultant Change in Field Sampling Procedure: ____________________

____

____

____

Special Equipment, Material, or Personnel Required: ____________________

____

____

Author's Name ____________________ Date: ____________

Approval: ____________________ Date: ____________

Title: ____________________

Figure F-13 SAMPLING ALTERATION CHECKLIST

W/O No. ________ Page____

LAB TRACKING REPORT: ___-___-___
(LOC-SN-FSC)

FRACTION CODE	X	PREP/ANAL REQUIRED	RESPONSIBLE INDIVIDUAL	DATE DELIVERED	DATE COMPLETED

Figure F-14 LABORATORY TRACKING REPORT

CORRECTIVE ACTIONS CHECKLIST

Sample Program Identification: ______________________________

Sampling Dates: ______________________________

Material to be Sampled: ______________________________

Measurement Parameter: ______________________________

Acceptable Data Range: ______________ ______________

____

Corrective Actions Initiated By: ______________________________

Title: ______________________________ Date: ______________

Problem Areas Requiring Corrective Action: ______________________________

____

____

____

____

____

Measures to Correct Problems: ______________________________

____

____

____

____

Means of Detecting Problems (field observations, systems audit, etc.): __

____

____

Approval for Corrective Actions: ______________________________

Title: ______________________________ Date: ______________

Signature: ______________________________

Figure F-15. CORRECTIVE ACTIONS CHECKLIST

SYSTEMS AUDIT CHECKLIST

Sample Program Identification : ______________________________

Sampling Dates: ______________________________

Material to be Sampled: ______________________________

Measurement Parameter: ______________________________

Sampling and Monitoring Equipment in Use:

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

Audit Procedures and Frequency: ______________________________

____

____

____

____

____

Field Calibration Procedures and Frequency: ____________________

____

____

____

Signature of QA Coordinator: ____________________ Date: __________

Figure F-16 SYSTEM AUDIT CHECKLIST

USEPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 — Alexandria, Virginia 22313
703/557-2490 FTS 8-557-2490

Sample No.

INORGANICS ANALYSIS DATA SHEET

LAB NAME ______________ CASE NO. ______________

LAB SAMPLE ID. NO. ______________ QC REPORT NO. ______________

Elements Identified and Measured

	ug/L or mg/kg (circle one)		ug/L or mg/kg (circle one)
1. Aluminum		13. Magnesium	
2. Antimony		14. Manganese	
3. Arsenic		15. Mercury	
4. Barium		16. Nickel	
5. Beryllium		17. Potassium	
6. Cadmium		18. Selenium	
7. Calcium		19. Silver	
8. Chromium		20. Sodium	
9. Cobalt		21. Thallium	
10. Copper		22. Tin	
11. Iron		23. Vanadium	
12. Lead		24. Zinc	

Cyanide ______________ Percent Solids ______________

For reporting results to EPA, the following result qualifiers are used. Additional flags or footnote explaining results are encouraged. Definition of such flags must be explicit, however.

Value If the result is a value greater than or equal to the detection limit, report the value.

U Indicates element was analyzed for but not detected. Report the detection limit value with the U (e.g., 10U).

J Indicates an estimated value or a value not reported due to the presence of interference J must be accompanied by explanatory not in cover letter.

s Indicates value determined by Method of Standard Addition.

Comments: ______________

Form I 6/8

Figure F-17 INORGANICS ANALYSIS DATA SHEET Example

USEPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 — Alexandria, Virginia 22313
703/557-2490 FTS 8-557-2490

Sample No. ______

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: ____________________ Case No: ____________________
Sample ID No: ____________________ QC Report No: ____________________
Sample Matrix: ____________________ Contract No.: ____________________
Data Release Authorized By: ____________________ Date Sample Received: ____________________

VOLATILES

CONCENTRATION: LOW MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: ____________________
DATE ANALYZED: ____________________
PERCENT MOISTURE: ____________________

PP #	CAS #		ug/l or ug/kg (circle one)
(2V)	107-02-8	acrolein	
(3V)	107-13-1	acrylonitrile	
(4V)	71-43-2	benzene	
(6V)	56-23-5	carbon tetrachloride	
(7V)	108-90-7	chlorobenzene	
(10V)	107-06-2	1,2-dichloroethane	
(11V)	71-55-6	1,1,1-trichloroethane	
(13V)	75-34-3	1,1-dichloroethane	
(14V)	79-00-5	1,1,2-trichloroethane	
(15V)	79-34-5	1,1,2,2-tetrachloroethane	
	75-00-3	chloroethane	
(19V)	110-75-8	2-chloroethylvinyl ether	
(23V)	67-66-3	chloroform	
(29V)	75-35-4	1,1-dichloroethene	
(30V)	156-60-5	trans-1,2-dichloroethene	
(32V)	78-87-5	1,2-dichloropropane	
(33V)	10061-02-6	trans-1,3-dichloropropene	
	10061-01-05	cis-1,3-dichloropropene	
(38V)	100-41-4	ethylbenzene	
(44V)	75-09-2	methylene chloride	
(45V)	74-87-3	chloromethane	
(46V)	74-83-9	bromomethane	
(47V)	75-25-2	bromoform	
(48V)	75-27-4	bromodichloromethane	
(49V)	75-69-4	fluorotrichloromethane	
(50V)	75-71-8	dichlorodifluoromethane	
(51V)	124-48-1	chlorodibromomethane	
(85V)	127-18-4	tetrachloroethene	
(86V)	108-88-3	toluene	
(87V)	79-01-6	trichloroethene	
(88V)	75-01-4	vinyl chloride	
	67-64-1	acetone	
	78-93-3	2-butanone	
	75-15-0	carbondisulfide	
	519-78-6	2-hexanone	
	108-10-1	4-methyl-2-pentanone	
	100-42-5	styrene	

PESTICIDES

CONCENTRATION: LOW MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: ____________________
DATE ANALYZED: ____________________
PERCENT MOISTURE: ____________________

PP #	CAS #		ug/l or ug/kg (circle one)
(89P)	309-00-2	aldrin	
(90P)	60-57-1	dieldrin	
(91P)	57-74-9	chlordane	
(92P)	50-29-3	4,4'-DDT	
(93P)	72-55-9	4,4'-DDE	
(94P)	72-54-8	4,4'-DDD	
(95P)	115-29-7	α-endosulfan	
(96P)	115-29-7	β-endosulfan	
(97P)	1031-07-8	endosulfan sulfate	
(98P)	72-20-8	endrin	
(99P)	7421-93-4	endrin aldehyde	
(100P)	76-44-8	heptachlor	
(101P)	1024-57-3	heptachlor epoxide	
(102P)	319-84-6	α-BHC	
(103P)	319-85-7	β-BHC	
(104P)	319-86-8	δ-BHC	
(105P)	58-89-9	γ-BHC (lindane)	
(106P)	53469-21-9	PCB-1242	
(107P)	11097-69-1	PCB-1254	
(108P)	11104-28-2	PCB-1221	
(109P)	11141-16-5	PCB-1232	
(110P)	12672-29-6	PCB-1248	
(111P)	11096-82-5	PCB-1260	
(112P)	12674-11-2	PCB-1016	
(113P)	8001-35-2	toxaphene	

DIOXINS

CONCENTRATION: LOW MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: ____________________
DATE ANALYZED: ____________________
PERCENT MOISTURE: ____________________

PP #	CAS #		ug/l or ug/kg (circle one)
(129B)	1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	

Figure F-18 ORGANICS ANALYSIS DATA SHEET Example
(1st of 2 sheets)

USEPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 — Alexandria, Virginia 22313
703/557-2490 FTS 8-557-2490

Sample No.

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: ____________________ Case No: ____________________

Sample ID No: ____________________ QC Report No: ____________________

Sample Matrix: ____________________ Contract No.: ____________________

Data Release Authorized By: ____________________ Date Sample Received: ____________________

SEMIVOLATILE COMPOUNDS

CONCENTRATION: LOW MEDIUM HIGH (circle one)

DATE EXTRACTED/PREPARED: ____________________

DATE ANALYZED: ____________________

PERCENT MOISTURE: ____________________

PP #	CAS #		ug/l or ug/kg (circle one)
(21A)	88-06-2	2,4,6-trichlorophenol	
(22A)	59-50-7	p-chloro-m-cresol	
(24A)	95-57-8	2-chlorophenol	
(31A)	120-83-2	2,4-dichlorophenol	
(34A)	105-67-9	2,4-dimethylphenol	
(57A)	88-75-5	2-nitrophenol	
(58A)	100-02-7	4-nitrophenol	
.A)	51-28-5	2,4-dinitrophenol	
(60A)	534-52-1	4,6-dinitro-2-methylphenol	
(64A)	87-86-5	pentachlorophenol	
(65A)	108-95-2	phenol	
	65-85-0	benzoic acid	
	95-48-7	2-methylphenol	
	108-39-4	4-methylphenol	
	95-95-4	2,4,5-trichlorophenol	
(1B)	83-32-9	acenaphthene	
(5B)	92-87-5	benzidine	
(8B)	120-82-1	1,2,4-trichlorobenzene	
(9B)	118-74-1	hexachlorobenzene	
(12B)	67-72-1	hexachloroethane	
(18B)	111-44-4	bis(2-chloroethyl)ether	
(20B)	91-58-7	2-chloronaphthalene	
(25B)	95-50-1	1,2-dichlorobenzene	
(26B)	541-73-1	1,3-dichlorobenzene	
(27B)	106-46-7	1,4-dichlorobenzene	
(28B)	91-94-1	3,3'-dichlorobenzidine	
(35B)	121-14-2	2,4-dinitrotoluene	
(36B)	606-20-2	2,6-dinitrotoluene	
3)	122-66-7	1,2-diphenylhydrazine	
(39B)	206-44-0	fluoranthene	
(40B)	7005-72-3	4-chlorophenyl phenyl ether	
(41B)	101-55-3	4-bromophenyl phenyl ether	
(42B)	39638-32-9	bis (2-chloroisopropyl) ether	

PP #	CAS #		ug/l or ug/kg (circle one)
(52B)	87-68-3	hexachlorobutadiene	
(53B)	77-47-4	hexachlorocyclopentadiene	
(54B)	78-59-1	isophorone	
(55B)	91-20-3	naphthalene	
(56B)	98-95-3	nitrobenzene	
(62B)	86-30-6	N-nitrosodiphenylamine	
(63B)	621-64-7	N-nitrosodipropylamine	
(66B)	117-81-7	bis (2-ethylhexyl) phthalate	
(67B)	85-68-7	benzyl butyl phthalate	
(68B)	84-74-2	di-n-butyl phthalate	
(69B)	117-84-0	di-n-octyl phthalate	
(70B)	84-66-2	diethyl phthalate	
(71B)	131-11-3	dimethyl phthalate	
(72B)	56-55-3	benzo(a)anthracene	
(73B)	50-32-8	benzo(a)pyrene	
(74B)	205-99-2	benzo(b)fluoranthene	
(75B)	207-08-9	benzo(k)fluoranthene	
(76B)	218-01-9	chrysene	
(77B)	208-96-8	acenaphthylene	
(78B)	120-12-7	anthracene	
(79B)	191-24-2	benzo(ghi)perylene	
(80B)	86-73-7	fluorene	
(81B)	85-01-8	phenanthrene	
(82B)	53-70-3	dibenzo(a,h)anthracene	
(83B)	193-39-5	indeno(1,2,3-cd)pyrene	
(84B)	129-00-0	pyrene	
	62-53-3	aniline	
	100-51-6	benzyl alcohol	
	106-47-8	4-chloroaniline	
	132-64-9	dibenzofuran	
	91-57-6	2-methylnaphthalene	
	88-74-4	2-nitroaniline	
	99-09-2	3-nitroaniline	

Figure F-18 ORGANICCS ANALYSIS DATA SHEET Example
(2nd of 2 sheets)

FIELD AUDIT CHECKLIST

Briefing with SPM

PROJECT NO. ____________ DATE OF AUDIT ____________

PROJECT MANAGER ____________ SIGNATURE OF AUDITOR ____________

OFFICE LOCATION ____________

Yes __ No __ N/A __ 1. Was a QA Project Plan and a Site Health and Safety Plan plan prepared? If yes, what items are addressed in the plan?

Comments: ____________

Yes __ No __ N/A __ 2. Was a briefing held with project participants?

Comments: ____________

Yes __ No __ N/A __ 3. Were additional instructions given to project participants (i.e., changes in project plan)?

Comments: ____________

Yes __ No __ N/A __ 4. Is there a written list of sampling locations and descriptions?

Comments: ____________

Figure F-19 FIELD AUDIT CHECKLIST: Briefing with SPM (1st of 2 sheets)

Yes __ No __ N/A __ 5. Is there a map of sampling locations?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 6. Does the sampling team follow a system of accountable documents?

If yes, what documents are accountable?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Is there a list of accountable field documents checked out to the SPM or designated person?

If yes, who checked them out?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Is the transfer of field documents (Sample I.D. Tags, Chain of Custody Records, logbooks, etc.) from the SPM to the field participants documented in a logbook?

Comments: ______________________________

____

____

Figure F-19 FIELD AUDIT CHECKLIST: Briefing with SPM (2nd of 2 sheets)

FIELD AUDIT CHECKLIST

Field Observations

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT MANAGER ____________________ SIGNATURE OF AUDITOR ____________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Was permission granted to enter and inspect the facility?

Comments: ____________________

____

____

Yes __ No __ N/A __ 2. Is permission to enter the facility documented?

Comments: ____________________

____

____

Yes __ No __ N/A __ 3. Were split samples offered to the facility? If yes, was the offer accepted or declined?

Comments: ____________________

____

____

Yes __ No __ N/A __ 4. If the offer to split samples was accepted, were the split samples collected?

Comments: ____________________

____

____

Yes __ No __ N/A __ 5. Is the offering of split samples recorded?

Comments: ____________________

____

____

Figure F-20 FIELD AUDIT CHECKLIST: Field Observations
(1st of 3 sheets)

Yes __ No __ N/A __ 6. If split samples were collected, are they documented?

If yes, where are they documented?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Are the number, frequency, and types of field measurements and observations taken as specified in the project plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Are field measurements recorded (pH, temperature, conductivity, etc.)? Where?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 9. Are samples collected in the types of containers specified in the project plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 10. Are samples preserved as specified in the Project Plan or as directed by the SPM?

Comments: ______________________________

____

____

Figure F-20 FIELD AUDIT CHECKLIST: Field Observations
(2nd of 3 sheets)

Yes __ No __ N/A __ 11. Are the number, frequency, and types of samples collected as specified in the Project Plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 12. Are samples packed for preservation as specified in the Project Plan (i.e., packed in ice, etc.)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 13. Is sample custody maintained at all times?

Comments: ______________________________

____

____

Figure F-20 FIELD AUDIT CHECKLIST: Field Observations
(3rd of 3 sheets)

FIELD AUDIT CHECKLIST

Document Control

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT MANAGER ____________________ SIGNATURE OF AUDITOR ____________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Have all unused and voided accountable documents been returned to the SPM by the team members?

Comments: ____________________

Yes __ No __ N/A __ 2. Have document numbers of all lost or destroyed accountable documents been recorded in the SPM's logbook?

Comments: ____________________

Yes __ No __ N/A __ 3. Are all samples identified with Sample I.D. Tags?

Comments: ____________________

Yes __ No __ N/A __ 4. Are all Sample I.D. Tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)?

Comments: ____________________

Figure F-21 FIELD AUDIT CHECKLIST: Document Control (1st of 5 sheets)

Yes __ No __ N/A __ 5. Are all samples collected listed on a Chain-of-Custody Record?
If yes, describe the type of Chain of Custody Record used.
Comments: ________________________________

Yes __ No __ N/A __ 6. Are the Sample I.D. Tag numbers recorded on the Chain of Custody Records?
Comments: ________________________________

Yes __ No __ N/A __ 7. Does information on Sample I.D. Tags and Chain of Custody Records match?
Comments: ________________________________

Yes __ No __ N/A __ 8. Do the Chain of Custody Records indicate the method of sample shipment?
Comments: ________________________________

Yes __ No __ N/A __ 9. Is a Chain of Custody record included with the samples in the shipping container?
Comments: ________________________________

Figure F-21 FIELD AUDIT CHECKLIST: Document Control
(2nd of 5 sheets)

Yes __ No __ N/A __ 10. Do the sample traffic reports agree with the Sample I.D. Tags?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 11. If required, has a copy of a Receipt For Samples form been provided to the facility?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 12. If required, was the offer of a receipt for samples documented?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 13. If used, are blank samples identified?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 14. If collected, are duplicate samples identified on Sample I.D. Tags and Chain of Custody Records?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 15. If used, are spiked samples identified?

Comments: ______________________________

____

____

Figure F-21 FIELD AUDIT CHECKLIST: Document Control
(3rd of 5 sheets)

Yes __ No __ N/A __ 16. Are Field Notebooks signed by the individual who checked out the notebook from the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 17. Are Field Notebooks dated upon receipt from the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 18. Are Field Notebooks project-specific (by notebook or by page)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 19. Are Field Notebook entries dated and identified by author?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 20. Is the facility's approval or disapproval to take photographs noted in a Field Notebook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 21. Are photographs documented in Field Notebooks (e.g., time, date, description of subject, photographer, etc.)?

Comments: ______________________________

____

____

Figure F-21 FIELD AUDIT CHECKLIST: Document Control
(4th of 5 sheets)

Yes __ No __ N/A __ 22. If a Polaroid camera is used, are photos matched with Field Notebook documentation?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 23. Are Sample I.D. Tag numbers recorded in the SPM logbook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 24. Are Quality Control checks documented (i.e., calibration of pH meters, conductivity meters, etc.)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 25. Are amendments to the Project Plan documented (on the Project Plan itself, in a project logbook, elsewhere)?

Comments: ______________________________

____

____

Figure F-21 FIELD AUDIT CHECKLIST: Document Control (5th of 5 sheets)

FIELD AUDIT CHECKLIST

Debriefing with SPM or
Field Sampling Team Leader

PROJECT NO. ____________ DATE OF AUDIT ____________
PROJECT MANAGER ____________ SIGNATURE OF AUDITOR ____________
OFFICE LOCATION ____________

Yes __ No __ N/A __ 1. Was a debriefing held with project participants after the audit was completed?
Comments: ____________

Yes __ No __ N/A __ 2. Were any recommendations made to project participants during the debriefing?
If yes, briefly describe what recommendations were made.
Comments: ____________

Figure F-22 FIELD AUDIT CHECKLIST: Debriefing with SPM ...

DOCUMENT AUDIT CHECKLIST

Closed Files

PROJECT NO. ________________ DATE OF AUDIT ____________________

PROJECT LOCATION ____________ SIGNATURE OF AUDITOR ______________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Have individual files been assembled (field investigation, laboratory, other)?

Comments: ____________________

Yes __ No __ N/A __ 2. Is each file inventoried?

Comments: ____________________

Yes __ No __ N/A __ 3. Is a document numbering sytem used?

Comments: ____________________

Yes __ No __ N/A __ 4. Has each document been assigned a document control number?

Comments: ____________________

Yes __ No __ N/A __ 5. Are all documents listed on the inventory accounted for?

Comments: ____________________

Figure 23 DOCUMENT AUDIT CHECKLIST: Closed Files (1st of 2 sheets)

Yes __ No __ N/A __ 6. Are there any documents in the file that are not on the inventory?

Comments: ______________________________________

Yes __ No __ N/A __ 7. Is the file stored in a secure area?

Comments: ______________________________________

Yes __ No __ N/A __ 8. Are there any project documents that have been declared enforcement sensitive?

Comments: ______________________________________

Figure F-23 DOCUMENT AUDIT CHECKLIST: Closed Files (2nd of 2 sheets)

DOCUMENT AUDIT CHECKLIST

Enforcement Sensitive Documents

PROJECT NO. ________________ DATE OF AUDIT ________________

PROJECT LOCATION ____________ SIGNATURE OF AUDITOR ____________

OFFICE LOCATION ________________________________

Yes __ No __ N/A __ 1. Are Enforcement Sensitive documents stored in a secure area separate from other project documents?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 2. Are Enforcement Sensitive documents listed in the project file?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 3. Is access to Enforcement Sensitive files restricted?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 4. Have classified documents been marked or stamped "Enforcement Sensitive?"

Comments: ________________________________

____

____

Figure F-24 DOCUMENT AUDIT CHECKLIST: Enforcement Sensitive Documents (1st of 2 sheets)

Yes ___ No ___ N/A ___ 5. Is classified information inventoried?

Comments: ______________________________

____

____

Yes ___ No ___ N/A ___ 6. Is classified information numbered for document control?

Comments: ______________________________

____

____

Figure F-24 DOCUMENT AUDIT CHECKLIST: Enforcement Sensitive Documents (2nd of 2 sheets)

DOCUMENT AUDIT CHECKLIST

Active Project Files

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT LOCATION ____________________ SIGNATURE OF AUDITOR ____________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Are project notebooks being maintained in accordance with policies?

Comments: ____________________

____

____

Yes __ No __ N/A __ 2. Are project activities logbooks being kept up to date?

Comments: ____________________

____

____

Yes __ No __ N/A __ 3. Is each entry in the project activities logbook identified by date and author, if made by persons not originally assigned to the book?

Comments: ____________________

____

____

Yes __ No __ N/A __ 4. Are entries legible, factual, and made in ink?

Comments: ____________________

____

____

Figure F-25 DOCUMENT AUDIT CHECKLIST: Active Project Files (1st of 3 sheets)

Yes __ No __ N/A __ 5. Are modifications to the project workplan noted in the project activities logbook or elsewhere?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 6. Is an inventory of serialized field documents (Sample I.D. Tags, Chain of Custody Records, etc.) in the DCO's inventory logbook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Does the Field Notebook contain adequate information about each sample including the Sample I.D. Tag number, date, location, and information necessary to reconstruct the sample?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Are entries to the Field Notebook made in ink?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 9. Are corrections properly executed with one line through the error in all project logbooks and Field Notebooks?

Comments: ______________________________

____

____

Figure F-25 DOCUMENT AUDIT CHECKLIST: Active Project Files (2nd of 3 sheets)

Yes ___ No ___ N/A ___ 10. Are all project notebooks and logbooks properly labeled with the project number, EPA site number and title?

Comments: ______________________________________

____

____

Figure F-25 DOCUMENT AUDIT CHECKLIST: Active Project Files
(3rd of 3 sheets)

DOCUMENT AUDIT CHECKLIST

Regional Document Control Officer

OFFICE LOCATION ______________________________

DATE OF AUDIT ______________________________

SIGNATURE OF AUDITOR ______________________________

Yes __ No __ N/A __ 1. Is an inventory of serialized field documents (Sample I.D. Tags, Chain of Custody Records, Receipt for Samples Form, etc) in the DCO's inventory logbook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 2. Are project materials secured during other than working hours unless they are in use?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 3. Is Enforcement Sensitive material maintained in a secured area with a checkout log at all times?

Comments: ______________________________

____

____

Figure F-26 DOCUMENT AUDIT CHECKLIST: Regional Document Control Officer

VOLATILE ORGANIC FIELD ANALYSIS

Sample Identification No.______________________________

Date:__________________ Task No.____________________

Depth Interval (ft)	HNU Photo-ionizer Reading (ppm)

Figure F-27 VOLATILE ORGANIC FIELD ANALYSIS

FIELD CONTACT FORM

Inspector's Name: ______________________________

Organization: ______________________________

Date of Contact: ______________________________

Contact Name: ______________________________

Agency: ______________________________

Address: ______________________________

____

Tel. No.: ______________________________

Contact Summary

____

____

____

____

____

____

____

____

____

____

COPY:

Figure F-28 FIELD CONTACT FORM

Figure F-29 Field Gas Analysis Form

FIELD GAS ANALYSIS				SITE: P.N.:			
SAMPLE I.D. NUMBER	SAMPLE LOCATION	DATE	TIME	SAMPLE TYPE	SAMPLING INSTRUMENT	READING (UNITS)	COMMENTS

17.07 APPENDIX G

BORING LOG TERMINOLOGY

17.07 BORING LOG TERMINOLOGY

17.07.1 General

PP	- Compressive strength as determined by penetrometer
TV	- Compressive strength as determined by torvane
Gravel	- From 1/4 inch to 3 inches in diameter
Cobble	- From 3 to 12 inches in diameter
Boulder	- Greater than 12 inches in diameter
60°	- Represents 60 degrees measured from a plane perpendicular to the longitudinal axis of the core
Trace	- Represents 0 to 10 per cent by volume
Some	- Represents 10 to 25 per cent by volume
N Value	- Indicates the number of blows required to drive a standard split spoon sampler 12 inches with a 140-pound weight falling 30 inches
REC	- Recovery indicates total amount of core recovered for each run. Expressed as a percentage of the total length of the core run
RQD	- A modified core recovery in which all pieces of sound core over 4 inches in length are counted as recovery. The modified sum of core recovered is then expressed as a percentage of the total length of the core run
---	- Dashed line in classification column indicates approximate or gradational change

17.07.2 Weathering

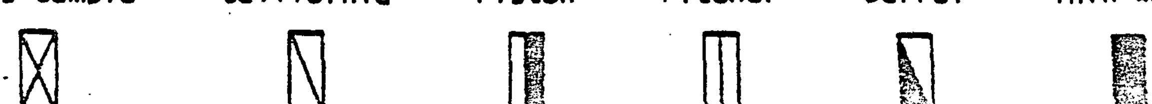
Fresh	- The rock shows no discoloration, loss of strength, or any other effect due to weathering (unweathered rock)
Slightly Weathered	- Rock is slightly discolored with a slightly lower strength than unweathered rock
Moderately Weathered	- Rock is considerably discolored with a significantly lower strength than unweathered rock
Highly Weathered	- Rock is discolored and weakened so intensely that 2-inch diameter rock cores can be broken readily by hand. Wet strength is usually much lower than dry strength

17.07.3 Bedding

Laminated	- Less than 0.001 foot to 0.01 foot (.1 inch)
Thin Bedded	- 0.01 foot to 0.1 foot (.1 to 1.2 inches)
Medium Bedded	- 0.1 foot to 1.0 foot (1.2 to 12 inches)
Thick Bedded	- Greater than 1.0 foot
Massive	- Denotes no discernible internal bedding structure

17.07.4 Sample Symbols

Bag or Grab Sample	California	Piston	Pitcher	Split Barrel	Thin Wall



17.08 APPENDIX H

SAMPLE BOTTLE REPOSITORY PROGRAM

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17.08 SAMPLE BOTTLE REPOSITORY PROGRAM

In addition to its analytical programs, the CLP provides several supplementary services. These activities have developed as a natural adjunct to the program's analytical services. The purpose of this chapter is to provide the user with a description of each auxiliary program service and how the service may be accessed.

17.08.1 Sample Bottle Repository Program

17.08.1.1 Types and Quantities of Bottles Available. Under the Sample Bottle Repository operation, nine types of sample containers are available to CLP clients for use in hazardous waste sampling activities of the Superfund Program. Bottles provided through this program are pre-cleaned and QC tested according to prescribed procedures to ensure that no contamination exists that might affect sample data results.

Clean, empty bottles, and closures are shipped to users in protective cardboard cartons. (Sample coolers and sample preserving agents are not supplied through the Repository program.)

The following chart lists the types of bottles provided through this program, the case sizes in which bottles are shipped, and the type(s) of samples appropriate for collection in each bottle type. Each bottle type is cleaned and QC tested by procedures directly related to the specific analyses that may be performed on samples collected in the bottle. Therefore, to ensure appropriate quality control, users are instructed to utilize bottles only to collect sample types as listed on the following chart.

TABLE H-1 SAMPLE BOTTLE REPOSITORY SERVICES

Container Type	Description	No. Per Case	Used for RAS Sample Type*
1	1/2 gallon amber glass bottle with Teflon-lined black phenolic cap	6	Extractable Organics Low Concentration Water Samples
2	40-ml glass vial with Teflon-backed silicon septum cap	72	Volatile Organics Low & Medium Concentration Water Samples
3	1-liter high-density polyethylene bottle with polyethylene cap	42	Metals, Cyanide Low Concentration Water Samples
4	120-ml wide-mouth glass vial with polyethylene cap (white)	72	Volatile Organics Low & Medium Concentration Soil Samples
5	16-oz wide-mouth glass jar with Teflon-lined black phenolic cap	48	Metals, Cyanide Medium Concentration Water Samples
6	8-oz wide-mouth glass jar with Teflon-lined Black phenolic cap	96	Extractable Organics Low & Medium Concentration Soil Samples and Metals, Cyanide Low & Medium Concentration Soil Samples and Dioxin Soil Samples and Organics & Inorganics High Concentration Liquid & Solid Samples

TABLE H-1 SAMPLE BOTTLE REPOSITORY SERVICES
(Continued)

Container Type	Description	No. Per Case	Used for RAS Sample Type*
7	4-oz wide-mouth glass jar with Teflon-lined black phenolic cap.	120	Extractable Organics Low & Medium Concentration Soil Samples and Metals, Cyanide Low & Medium Concentration Soil Samples and Dioxin Soil Samples and Organic & Inorganic High Concentration Liquid & Solid Samples
8	1-liter amber glass bottle with Teflon-lined black phenolic cap	30	Extractable Organics Low Concentration Water Samples
9	32-oz wide-mouth glass jar with Teflon-lined black phenolic cap	36	Extractable Organics Medium Concentration Water Samples

*This column specifies the only type(s) of samples that should be collected in each container for Repository Authorized Service (RAS).

17.08.1.2 Ordering Procedures. The Sample Bottle Repository program may be used by any organization scheduling samples through the CLP and is commonly accessed by regional and remedial contractor clients. Two individuals from each organization are designated by SMO as Repository Authorized Requestors (RARs), and only these individuals may place bottle orders through the program. State personnel should access the bottle program through their EPA Regional office.

Users should contact SMO initially to become authorized to order from the Repository and to obtain a supply of Delivery Order forms. Thereafter, the RAR orders bottles directly from the repository. Since the repository can respond only to orders submitted by a SMO designated RAR, users must notify SMO of any change in RAR designations.

There are three types of bottle orders, defined by the amount of time between the date the order is placed and the requested delivery date:

- Routine Order: Ten or more working days lead time for delivery.
- Fast Turnaround Order: More than three days, but less than ten days lead time for delivery.
- Emergency Order: Less than three days lead time for delivery.

Routine orders are mailed to the repository utilizing the Delivery Order (DO), a four-part carbonless form. The DO must be signed by an RAR. The first two copies of the completed DO are sent to the repository at the address indicated on the form, the third copy is sent to SMO, and the fourth copy is retained for the user's file.

Fast turnaround and emergency orders should be called in to the repository, at the telephone number provided on the form, and the written DO distributed as outlined above, to confirm the order. When placing a telephone order, the RAR must give the repository the DO number for the order and provide the corresponding written DO in followup.

Users should submit orders a minimum of two weeks in advance of the required delivery date, whenever possible, to ensure timely and complete delivery of bottles. Emergency and fast turnaround orders are filled on an "as available" basis from the repository's emergency inventory stock. It may not be possible to respond to all emergency and fast turnaround orders, as response depends on repository inventory and orders in process.

In the event that an order is cancelled, the user must immediately contact the repository verbally to cancel the order, and follow up with a cancellation memo to the repository, sending a copy of the memo to SMO. Cancellation memos, as well as all other project related correspondence, should cite the appropriate DO number.

17.08.1.3 Shipment Information. Upon receipt of the Delivery Order, repository personnel schedule shipment and begin preparing the order. Repository personnel immediately notify the RAR if for any reason the order cannot be met in full by the requested delivery date. Often, partial shipments can be arranged over several days to meet the client's requirement. If concurrent orders are received at the repository that cannot be filled in a timely manner and if partial shipments cannot be satisfactorily arranged, the repository immediately notifies SMO, which coordinates with the involved Regional Sample Control Center(s) in determining the priority of bottle orders based on the region's sampling needs.

Each carton in a repository shipment is marked "Box ___ of ___," and a Repository Packing List (PL) is included in Box 1 of each shipment, so that the designee can verify that the entire shipment has been received. In addition, the repository sends two copies of the shipping PL to the RAR at the time of shipment. The RAR confirms with the designee that the entire shipment was received in good condition, then enters the date of receipt and signs the packing list in the space indicated to confirm receipt. The RAR must return a copy of the signed packing list to SMO within seven days of shipment receipt.

17.08.1.4 Procedures for Problem Resolution.

- Resolving Problems Concerning Bottle Shipment. If there are problems relating to shipment (i.e., shipment does not arrive by scheduled date, shipment is incomplete, or contents are damaged), the shipment designee or RAR (as appropriate to the situation) should contact the repository immediately to resolve the problem. If the problem is not satisfactorily handled in this manner, the RAR should then contact SMO for resolution.
- Resolving Problems Concerning Bottle Contamination. If a user has definitive cause to suspect that container contamination may have affected sample analysis results, the concerned RSCC

should notify SMO by telephone and follow up with an explanatory memorandum directed to the appropriate NPO Project Officer (PO). The memorandum should include the following information: description of the problem, rationale for suspecting bottle contamination, supporting documentation (if available), and lot number(s) for all bottles concerned. Bottle lot numbers must be provided before any corrective action can be taken. Prior to requesting corrective action, the user should verify to the extent possible that the contamination encountered is not a result of either improper field procedures (e.g., use of contaminated water for field blanks) or poor laboratory practice (e.g., background contamination) and include this information as part of the rationale in the memorandum submitted to the NPO.

After review of submitted information, the PO notifies SMO to initiate appropriate followup action. Upon notification by SMO, the repository will first check the QC analysis record for the concerned lot(s) of containers and verify that contract procedures were correctly followed and that the lot passed the QC analysis. Should an error be identified in this process, the repository will notify SMO immediately.

As a second step, following PO authorization, the repository will pull the QC storage container for the bottle lot(s) and analyze the container(s) for suspected contaminants. SMO will notify the RSCC concerning the analysis results, so that if there is a contamination problem, analysis data from samples collected in other containers in that lot can be appropriately flagged. Should contamination be confirmed by analysis of the QC storage container, the repository will immediately identify the problem and correct procedures as necessary to resolve it. Should a widespread problem be identified at any time, RARs would be notified in a timely manner so that bottles could be pulled before use in the field.

17.08.1.5 Summary of Bottle Cleaning and Quality Control Procedures. Containers provided under this program are prepared in batches or lots of approximately 100 containers. (Exact lot sizes for each bottle type are determined, so that a bottle lot is not split between cases.) Bottles are cleaned in lot groups, utilizing procedures specifically designed to remove any possible contaminants. Different cleaning procedures are employed according to the container material and the type(s) of samples that will be collected in the container.

Each bottle lot is assigned a unique identifying number. This lot number is permanently affixed to each bottle in the lot, recorded in the repository logbook, and entered on the shipment packing list when bottles from that lot are shipped. For QA purposes, it is vital that each container's lot number be permanently associated with the sample collected in that particular container. Therefore, it is recommended that samplers record each container lot number and associated CLP sample numbers in their field records at the time that samples are collected.

The repository routinely performs QC analyses on one percent of the number of containers per lot. No lot is released for shipment until acceptable QC results are verified. QC analyses are performed by equivalent methods to those utilized in CLP RAS programs and are specific to the types of samples that may be collected in the container. If a container fails to pass the QC check, the associated lot of bottles is pulled and reprocessed through the system.

A QC release number is assigned to each lot of bottles that passes QC analysis and is marked on both the analysis and storage QC containers for each lot. The QC release number is cross-referenced with the lot number in repository records, so that all QC records can be accessed based on the lot number identification.

In addition to the QC analysis check, an additional bottle is removed from each lot and stored for QC purposes. QC storage containers are kept in a contaminant-free area of the repository, which is monitored for volatile compounds. The QC storage containers are retained as a backup to recheck for cleanliness, should possible contamination of a lot of bottles come into questions at a later date.

17.09 APPENDIX I

HEALTH AND SAFETY PLAN

THE SEAL OF THE STATE OF WASHINGTON 1889

HEALTH AND SAFETY PLAN
For
MIDWAY LANDFILL

Midway Landfill
Kent, Washington

October 3, 1985

State of Washington
Department of Ecology
Remedial Action Division
Office of
Hazardous Substances and Air Quality

Black & Veatch
Engineers-Architects

1.0 INTRODUCTION

1.1 OBJECTIVES OF PROJECT

The following is a health and safety plan for remedial investigation activities at Midway Landfill, Kent, Washington. Specifically, this document addresses the health and safety issues involved with the activities outlined in the "Final Sampling and Analysis Plan" for Midway Landfill.

1.1.1 Investigation Objectives

Field activities to be performed at Midway Landfill are discussed in the "Final Sampling and Analysis Plan" (September 5, 1985). These activities include the sampling of surface soils at fifteen (15) locations in the study area, installation and subsequent sampling of eight (8) groundwater monitoring wells, three (3) leachate monitoring wells, and twenty-three (23) gas probes. In addition, eighty (80) shallow gas probes and several deep gas probes will be installed and monitored offsite. Flow meters will be installed to quantify the amount of storm water entering the site. Upwind/downwind sampling of the ambient air will be conducted in conjunction with meteorlogical monitoring.

Wells within one (1) mile of the site will be inventoried, as well as the identification of potential receptors. The objectives of the project include the following:

- Characterization of the chemical composition of the leachate plume and landfill gases.
- Identification of the contaminant sources and determination of the present extent of leachate and landfill gas migration.
- Determination of the pathways of contaminant migration and transport rates.
- Identification of contamination receptors and specific on and offsite health and environmental effects.
- Provision of necessary and sufficient data for the feasibility study to establish remedial response objectives, identify and evaluate alternatives, develop remedial action design(s), and assess the adequacy of current closure activities.

1.1.2 Health & Safety Plan Objectives

The objectives of this plan are to address the health and safety issues that are specific to the field activities outlined in the "Final Sampling and Analysis Plan" (September 5, 1985). Specifically, the plan will:

- Discuss the hazards that exist in the field activities and evaluate them with respect to the health and safety of field personnel.

- Recommend safety procedures that minimize the possibility of injury to field personnel.

- Develop emergency procedures in the event of field related accidents.

1.2 TRAINING OF PERSONNEL

All field personnel will be required to read the Health & Safety Plan and sign a statement acknowledging their understanding of the material.

In addition, all personnel will be required to complete a training course in compliance with EPA order 1440.2. The training program will address the following subjects:

- Toxicology
- Hazards of contaminants present
- Personal protective clothing
- Respiratory protective equipment
- Emergency procedures
- Monitoring instruments
- Site entry and exit procedures
- Disciplinary procedures

The Site Manager will train all staff supporting the field effort for any site and task specific work that is needed.

1.3 REVISIONS AND ADDITIONS TO HEALTH SAFETY PLAN

All field work will stop and the Health & Safety Plan will be revised if unexpected hazards such as the following are encountered:

- Detection of radiation.
- Presence of unexpected contaminants near or above the TLV.
- Equipment (monitoring, personal protective) malfunction.
- Contamination requiring level A protection.

Field work will resume only after a revised Health & Safety Plan has been reviewed by WDOE. The Site Manager (Black & Veatch) is responsible for any stop work decisions.

1.4 GENERAL SITE INFORMATION

1.4.1 Background

After several years as a gravel mining site, the Midway Landfill began accepting solid waste for disposal in January, 1966. Local residents say that at the time, they were assured by City of Seattle representatives that only non-putrescible wastes would be buried there, mainly from the demolition of construction sites.

Precise data concerning the types and quantities of waste accepted at the Midway Landfill, especially in the early years of operation, is unavailable. Yet, evidence indicates that liquid and solid wastes containing solvents, inorganic and organic chemicals, heavy metals, pesticides, hydrocarbons, acids and other hazardous materials have been deposited at the site at least since 1979.

The Seattle Engineering Department's records show that between 1980 and 1982, quantities of paint sludges, oily wastewater, dyes, waste coolant, lead contaminated wastes and other toxic materials were deposited there.

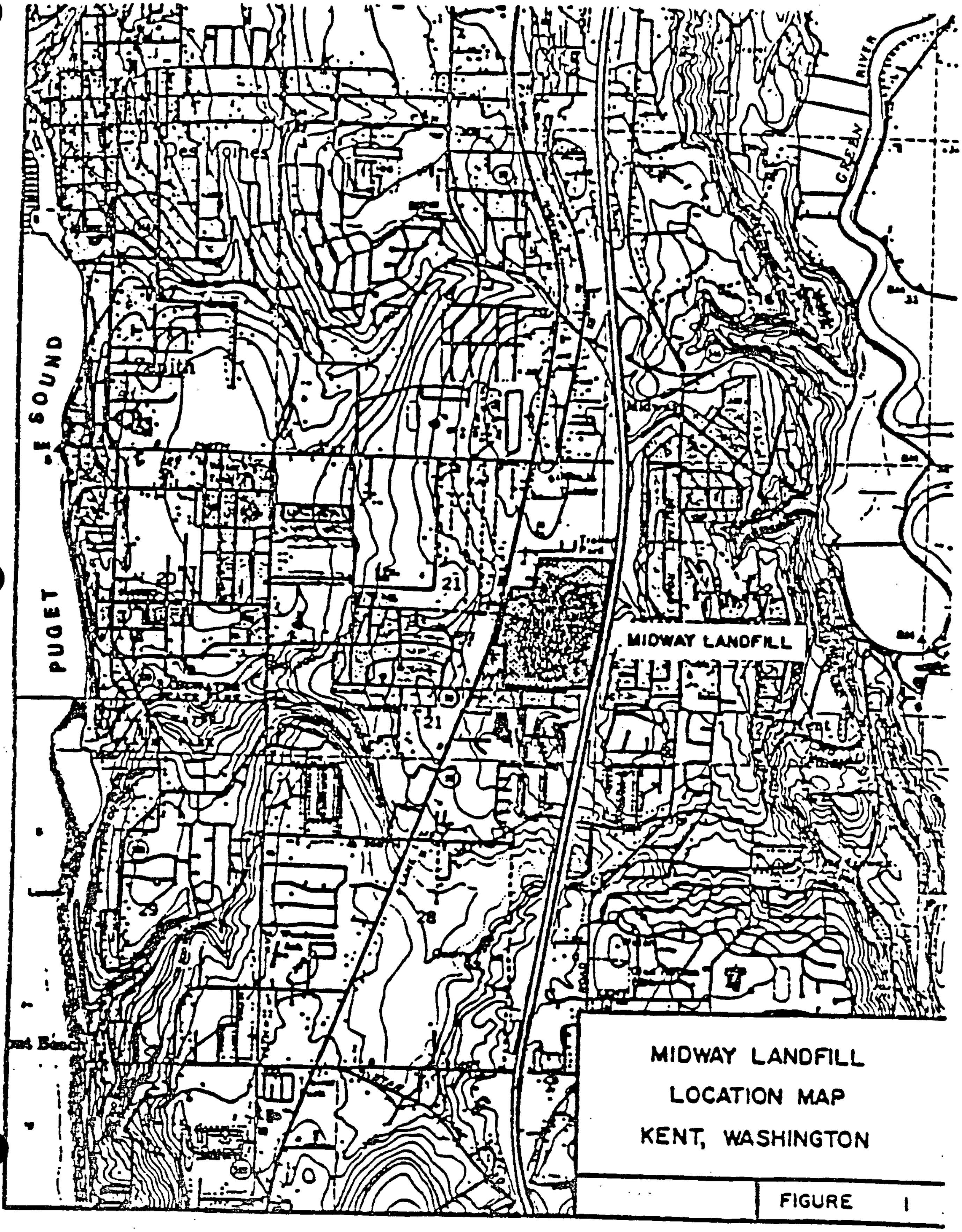
CERCLA files from EPA Region X documented that chemical wastes at Midway have been generated by a variety of industries, including construction, printing, steel and iron foundry, lab/hospital, utilities, general chemical and others.

Groundwater analyses performed on the site wells indicate the presence of heavy metals and organics contamination. The presence of methane gas in the landfill and migration of methane off the property has also caused concern over safety issues for surrounding residences and businesses. Recent monitoring efforts have detected methane offsite in nearby businesses and residences at levels within the explosive range. There is also evidence which indicates the landfill gas may also contain organic and inorganic vapors which constitute a serious health hazard. Because of the high gas levels and resultant concern over safety issues, WDOE has supported a fast-tract approach to gas probe installation.

1.4.2 Site Description

The Midway Landfill is a privately owned landfill that had been operated by the City of Seattle Solid Waste Utility from 1966 to 1983. The site consists of approximately 60 acres, located at South 248th and Pacific Highway South, inside the City of Kent, and is approximately 16 miles south of Seattle. The site is bordered on the east by Interstate 5. The site was formerly the location of a gravel mining operation and a peat bog lake, Lake Mead. The location and site boundaries are shown on Figure 1.

(WDOE 11889.401)
(MDLF-2)
(100285)


PUGET SOUND
GREEN RIVER
MIDWAY LANDFILL
MIDWAY LANDFILL
LOCATION MAP
KENT, WASHINGTON
FIGURE 1

1.4.3 Hazard Types and Characteristics

Hazards that may be encountered during field activities include:

- o Explosive atmosphere created by venting methane gas.
- o Exposure to volatile organic vapors contained in the landfill gas.
- o Exposure to trace inorganic vapors (specifically, hydrogen sulfide and hydrogen cyanide) contained in the landfill gas.
- o Exposure to contaminated groundwater and soil.
- o Oxygen deficient atmosphere developing as a result of displacement by landfill gas.
- o Physical hazards (i.e. broken glass, scrap metal) associated with municipal landfills.

1.4.4 Hazard Evaluation

Results of gas analyses on samples from landfill flares suggest that the landfill gas may contain hydrogen sulfide, benzene, and carbon tetrachloride in amounts exceeding the 1985 EPA threshold limit value (University of Washington, July 1985). These components have a relatively high potential to be liberated during drilling operations. Methane gas is explosive in concentrations between 5.3% and 15% (volume of methane in atmosphere). The possibility exists for the formation of an explosive atmosphere during drilling operations.

Hydrogen sulfide is a recognized irritant to the eyes and mucous membranes via inhalation route. Results of exposure range from eye irritation at low concentrations (20-150 ppm) to death at high concentrations. Hydrogen sulfide generally affects the respiratory and nervous systems. Hydrogen cyanide, which is often found in conjunction with hydrogen sulfide, should be considered present in the gas also. It is toxic via oral, dermal and inhalation routes. It is a protoplasmic poison, rendering oxygen unavailable to tissues.

Benzene is a recognized irritant to the skin and is a known leukemogen. Occasional exposure to high concentrations of benzene is not considered dangerous. Carbon tetrachloride is a recognized carcinogen and is highly toxic via oral and inhalation routes. It damages the kidneys, liver, and lungs. Exposure to concentrations greater than 1,000 ppm for several hours will cause symptoms of poisoning.

Results of groundwater analyses from monitoring wells indicate the presence of a wide range of volatile organics and heavy metals. The analyses indicates that the degree of contamination of groundwater is slight. However, there is a chance of exposure to volatile organics from the groundwater via inhalation or dermal routes. Exposure to heavy metals or inorganic contaminants is unlikely.

The types of contaminants that may be encountered in the installation at leachate monitoring wells are unknown at present. A prediction as to the types of contaminants present could be made based on waste disposal records and groundwater contaminants; however, this is not recommended due to the uncertainty of wastes disposed there.

The hazard evaluation for offsite gas probe installation is low but should be considered variable based on the uncertainty of concentrations of methane in the landfill gas. The chance of an explosive atmosphere developing can be easily minimized (see 3.1.2).

The hazard evaluation for the installation of groundwater monitoring wells is low to medium. The wells will be installed offsite, and based on available data, the groundwater is only slightly contaminated (ppb range). The hazard evaluation for leachate monitoring well installation is high based on the uncertainty of the types and concentrations of contaminants in the landfill gas, leachate, and soil.

Table 1-1

Respiratory Limits of Selected Contaminants in Landfill Gas

	CHEMICAL				
Respiratory Limits (1)	CH_4 (2)	H_2S	HCN (3)	C_6H_6	CCL_4
TLV	-	10	10	10	5
STEL	-	10	-	25	20
IDLH	-	300	50	2,000	300
OTL	-	1-5	1	100	50-75

(1) All values in parts per million
(2) Simple asphyxiant (non-toxic); therefore, no respiratory limits exist.
(3) Changes in TLV are being considered.
No STEL exists.
OTL is not useful due to the acute toxicity of HCN at this level.

2.0 SITE ORGANIZATION, LAYOUT, AND SAFETY EQUIPMENT

2.1 SITE ORGANIZATION

2.1.1 Project Team Members and Responsibilities

Black & Veatch will clearly designate responsibilities for management of Black & Veatch employee and subcontractor safety in the conduct of all aspects of the investigations. Responsibilities will range from intensive supervision and clearly stated policy by company management, through rigorous implementation of policy by middle management and team leaders, to a consistently high level of safety consciousness and feedback by team members. Subcontractors are expected to implement safe investigation procedures for their employees in conformance with contract requirements or specifications.

Responsibilities for implementing safe investigation procedures are described below.

2.1.1.1 Site Health and Safety Officer (Black & Veatch)

The Site Health and Safety Officer is responsible for overall coordination of safety matters within the project team. He advises the Site Manager regarding safety matters; recommends policy on matters not specifically addressed by other rules, regulations, and statutes, researches and disseminates information regarding known hazardous conditions, practices, or standards; coordinates safety training programs for project team personnel; consults with medical and industrial hygiene specialists as necessary; reviews corrective actions; evaluates new procedures; maintains awarness of parallel programs; refers to the Program Health & Safety Plan as needed.

This person also has the following responsibilities:

- o Calibrates monitoring instruments and assures they are working properly.
- o Interprets instrument readings and modifies current levels of safety based on interpretation of data.
- o Sets up decontamination procedures for personnel and equipment. Oversees decontamination implementation to assure contaminants are not being taken offsite.
- o Assures adequate supply of safety equipment is available and being properly utilized.
- o Assures that all personnel protective equipment is properly clean, maintained, and working according to specifications.
- o Assures that all personnel utilizing protective equipment are properly trained in its operation.

The Site Health & Safety Officer will have satisfactorily completed the EPA Personnel Protection and Safety course, be familiar with safety equipment to be used and competant in specifying levels of protection for field personnel. Mark Peterson (913)339-7224 is the designated Health & Safety Officer.

2.1.1.2 Industrial Hygiene Consultant (Black & Veatch)

The Industrial Hygiene Consultant provides specific information related to toxicology and medical practices in the event of personnel exposure to hazardous substances. The Industrial Hygiene Consultant will provide information concerning toxicology to personnel and local hospital personnel before site activities begin; partcipate in planning and presenting training sessions; consult with the Project Manager as necessary to determine specific individual's ability to perform field activities; interact with the Health and Safety Officer to maintain a complete, functional, and technically correct health and safety program. Phoenix Safety Associates, Ltd., (215)935-1770, is the designated Industrial Hygiene Consultant.

2.1.1.3 Site Manager (Black & Veatch)

The Site Manager is responsible for the overall implementation of the safety program at each site. Specifically, this includes providing adequate manpower, materials, equipment, and time resources to conduct an investigation safely and taking appropriate corrective action when unsafe acts or practices occur.

The Site Manager is also responsible for onsite enforcement of the health and safety program established in the Health & Safety Plan. He identifies unsafe conditions, practices, or procedures; researches and prepares reports pertaining to incidents resulting in physical injury or exposure to hazardous materials; disseminates information from the Project Manager and the Health and Safety Officer to onsite personnel and oversees safety related activities at the site. Mark Peterson is the designated Site Manager, (913)339-7224.

2.1.1.4 Employees (Black & Veatch)

Employees are responsible for complying with the health and safety program established in the Health & Safety Plan; reporting to their Site Manager any unsafe condition and all facts pertaining to incidents which result in physical injury or exposure to hazardous materials; and cooperation in the medical monitoring provision of this program.

Every person who participates in the investigation has a responsibility to report their experiences for the benefit of others. The reporting of favorable or unfavorable experiences will include recommendations to help others avoid discomfort, embarrassment, pain, or exposure to hazardous materials. The reporting will be summarized in writing, although initial reporting will be verbal.

2.1.2 Work Limitations

All field personnel will be required to pass a standard physical examination certifying they are in good health and are able to perform field activities outlined in the Site Sampling Plan. Work will be performed during daylight hours only and will be suspended if inclement weather conditions (i.e. heavy rain) make field work dangerous. Heat stress monitoring will be initiated to all field personnel wearing level B or C protection if the temperature exceeds 70 degrees fahrenheit. The monitoring will include hourly measurements of body temperature, blood pressure and pulse.

2.2 SITE LAYOUT

To reduce the potential for transfer of contamination from the site, work areas will be established. Within these areas prescribed operations will occur utilizing appropriate personnel protective equipment. This layout pertains to all activities occuring within Midway Landfill boundaries (onsite). Movement between areas, will be controlled at checkpoints. Three (3) contiguous areas are to be used as listed below:

1. Hot area.
2. Contamination reduction area.
3. Support area.

2.2.1 Hot Area

The hot area is the inner most area of the three areas and is considered contaminated. Within this area, prescribed levels of protection will be worn by all personnel. An entry checkpoint will be established at the periphery of the hot area to control the flow of personnel and equipment between it and the contamination reduction area and to check that entrance and exit procedures are followed. All land within the Midway Landfill boundary is considered the hot area.

2.2.2 Contamination Reduction Area

The area between the hot and support areas is the contamination reduction area. The purpose of this area is to prevent the transfer of contaminants which may have been picked up by personnel or equipment leaving the hot area. All decontamination activities will occur in this area.

The boundary between the hot area and the contamination reduction area is the hot line and access control station, located adjacent to the landfill boundaries, upwind whenever possible. The boundary between the contamination reduction area and the support area is the contamination control line and is 40 m. from the hot line.

2.2.3 Support Area

The support area is the outermost region and is considered a non-contantiminated or clean area. It will contain the field office, first aid area, and other elements necessary to support site activities. Change rooms, lunch and break areas, supplies, equipment storage, and maintenance areas will be located in this area. Onsite eating, drinking and smoking will be allowed only in this area. The support facility will be located upwind from the hot and contamination reduction areas whenever possible.

2.2.4 Gas Probe Installation

The installation of gas probes offsite is not expected to pose a serious hazard to field personnel. For this reason, a modified site layout is planned with a drill zone surrounded by a support zone. In areas where the arrangement below is not feasible, the Site Health & Safety Officer will reduce the dimensions of the two zones.

2.2.4.1 Drill Zone

The drill zone is the area within a 25 foot radius of the actual drill site. Surveying flags will be placed around this zone to distinguish it from the surrounding support zone.

2.2.4.2 Support Zone

The support zone surrounds the drill zone and is 20 feet wide. A rope barrier will separate the support zone from surrounding property. In addition, "KEEP OUT" or "NO TRESPASSING" signs will be attached to the rope.

2.2.5 Groundwater Monitoring Well Installation

The installation of groundwater monitoring wells is not expected to pose a serious hazard to field personnel; however, contaminated material may be generated, and a mini-decontamination station will be needed. The site plan for this activity will consist of an exclusion zone surrounded by a support zone.

2.2.5.1 Exclusion Zone

The area within a 50 foot radius of the bore hole is the exclusion zone; this may be decreased if the drill area is in a confined area (i.e. private yard).

2.2.5.2 Support Zone

The support zone is similar to the support zone discussed above but will include a mini decontamination station located upwind of the exclusion zone.

2.3 SAFETY EQUIPMENT

Directions to nearby hospitals, emergency telephone numbers and reporting instructions for ambulance, hospital, fire, police, and emergency rescue teams will be conspicuously posted at the support area. A three (3) foot piece of orange flagging will be attached to the drill rig to indicate the relative wind direction.

2.3.1 First-Aid Kits

One (1) first-aid kit, 16-unit (National Safety Council Data Sheet No. 202) or kit approved by the industrial hygiene consultant, will be provided at each drill site.

2.3.2 Portable Fire Extinguishers

Two (2), ten (10) pound portable fire extinguishers, Class BC Dry Chemical, will be maintained in proper operative condition, and readily available for use at each drill site.

2.3.3 Gas Monitoring Device

An MSA-361 gas monitoring device will be maintained in proper operative condition and continuously monitor the atmosphere at each drill site for (1) a developing explosive atmosphere; (2) an oxygen deficient atmosphere; and (3) dangerous levels of hydrogen sulfide. (See table 1-2).

2.3.4 Compressed Air Horns

Field personnel will be equipped with a compressed air horn in the event of an emergency.

2.3.5 SCBA

Each field team member working onsite or installing groundwater monitoring wells will have an SCBA equipped with 30 minute air supply available if level B protection is needed.

2.3.6 Organic Vapor Analyzer (OVA)

An OVA-128 will be maintained in proper operative condition and continuosly monitor and record organic vapor levels at the drill site.

2.3.7 Emergency Eye Wash Station

An eye wash station approved by the Site Health & Safety Officer will be located wherever field activities take place.

2.3.8 HNU Photoionization Detector (HNU)

An HNU - PI101 will be maintained in proper operative condition and continuously monitor organic vapor levels at the drill site.

2.3.9 Compressed Air Cylinders

Compressed air cylinders, face masks, and air lines, capable of supplying four (4) personnel with air, will be kept in the support zones at gas probe drill sites.

Table 1-2

Action Levels for Monitoring Equipment

Monitoring Device	Level	Action
MSA-361, Explosimeter	* 20% LEL	Immediate withdrawal, consult fire and explosion specialists
MSA-361, Oxygen Meter	* 25%	Immediate withdrawal, consult fire and explosion specialists
	* 19.5%	Level B protection
MSA-361, Hydrogen Sulfide	* 10ppm	Level B protection
HNU - PI101	1 ppm	Level C protection
	5 ppm	Level B protection
	500 ppm	Level A protection
OVA 138	* 5 ppm	Site Safety Officer's discretion

* Audible alarm will sound at this level

3.0 SAFETY PROCEDURES

3.1 SITE ENTRY PROCEDURES

Prior to the start of any field activities, all personnel will be briefed by the Site Safety Officer as to the level of protection to be used and any health and safety issues that may have arisen and not covered in the Midway Health & Safety Plan. All monitoring instruments will be checked for proper operation and calibrated. Monitoring instruments that will be taken into the field include:

HNU PI101.
MSA 361.
OVA 128.
Radiation detector.

Protective gear will be donned and checked by Site Safety Officer, and monitoring equipment activated.

3.1.1 Offsite Procedures

The drill rig will be positioned over the drill site with the front of the truck down wind of drill site. Fans will be positioned on each side of the rear of the truck. Each fan will be positioned approximately eight (8) feet from the bore hole. The MSA and HNU probes will be mounted on the rear of the truck approximately three (3) feet above the ground. An electric generator will power the fans. A secondary generator will be kept in the support zone, up wind of the drill site, in the event the primary generator fails. The MSA, HNU, and fans should be positioned as described and engaged prior to drilling. This will minimize the chance of an explosive atmosphere developing. Once the drilling effort has commenced, persons will enter the drill zone up wind of the drill site.

During the split spoon sampling, field personnel will position themselves perpendicular to the fans so that "dead air space" will not develop in front of their bodies. This keeps a dangerous atmosphere from developing and minimizes the chance of exposure to field personnel. In the event of generator malfunction the drill team should retreat to the support zone, engage the secondary generator and return to the drill zone. If both generators fail, or the OVA or MSA-361 alarms sound, all personnel will retreat to the support zone, don necessary level of protection and return to the drill zone.

3.2 PERSONNEL PROTECTIVE EQUIPMENT

Based on current site conditions, field personnel will enter hot area with modified level C protection (full face respirator and cartridge need not be worn - but be around neck or attached to body). Continuous monitoring will occur with the possibility of upgrade to level C or B protection (See Appendix A). This level of protection will also be worn by personnel involved in groundwater monitoring well installation.

A modified level D protection will be worn by all field personnel involved in offsite gas probe installation. Coveralls, outer boots, gloves, and escape mask are optional.

3.3 DECONTAMINATING PROCEDURES

Decontamination procedures will vary considerably between onsite and offsite activities; the onsite procedures being much more thorough.

3.3.1 <u>Landfill Decontamination Procedure</u>

All personnel and equipment exiting the hot area (i.e. landfill property) are assumed to be grossly contaminated. The following contamination reduction procedure presumes this but can be modified with the Site Safety Officer's approval.

STATION A - A Plastic ground sheet on which field equipment is dropped by returning members of the work party.

STATION B - A wash tub filled with "ALKANOX" detergent solution.

- A second wash tub filled with rinse solution.

- Each wash tub should be equipped with a large sponge and brush.

STATION C - A bench or stool with disposable seat covers for personnel to sit on during removal of boot covers.

- A ten (10) gallon pail with plastic liner where disposable boot covers are discarded.

STATION D - Two ten (10) gallon buckets filled with "ALKANOX" solution.

STATION E - A ten (10) gallon bucket filled with rinse solution.

STATION F - A 32 gallon trash can with plastic liner (container for rubber items).

STATION G - 30 meters upwind from Station F. - A plastic ground sheet for SCBA drop.

STATION H - A bench or stool for personnel.

- A 32-gallon trash can with plastic liner (container for cloth items).

STATION I - A field shower setup.

STATION J - A redressing and first-aid station. This station defines the boundary between the decontamination area and the support area.

These stations will lie in a straight line between the two control access points located at the hot line and contamination control lines, respectively. Personnel working in the contamination reduction area will be required to wear a level of protection dictated by the Site Safety Officer.

3.3.2 Offsite Decontamination Procedures

This decontamination procedure pertains to groundwater monitoring well installation. Personnel exiting exclusion zone will drop contaminated sampling equipment on a polyethylene drop cloth and uncontaminated equipment on a second drop cloth. Personnel will proceed to a tub and scrub boots and gloves with "ALKANOX" detergent solution. Personnel will rinse in second tub with tap water. ALKANOX and water will be stored in pump sprayers. Outer gloves and boots will be doffed and stored. Tyvek suit will be doffed and disposed of.

During the offsite gas probe installation, it is not anticipated that a situation will develop such that decontamination procedures would have to be implemented. If leachate is encountered, though, appropriate decontamination procedures will be followed.

3.3.3 Vehicle Decontamination

Drilling rigs used in the hot area or exclusion zone will be decontaminated. Vehicles will be placed over a polyethylene sheet and steam cleaned. An absorbent material will be used to capture wash water. This material will be drummed and kept onsite until its degree of contamination, if any can be determined.

3.4 DISPOSAL OF INVESTIGATION DERIVED MATERIAL

All material generated as a result of field activities will be stored onsite and disposed of as outlined in the contractor specifications. Confirmation from WDOE will be obtained before any investigation derived material is disposed of.

3.5 GENERAL SAFETY PRECAUTIONS

1. Eating, drinking, chewing gum or tobacco, or taking medication in the hot area or contamination reduction area is strictly prohibited. The use of open flames or smoking near the drill site is strictly prohibited. Any engines used near the drill site will be equipped with spark arrestors.

2. Hands and face will be washed thououghly upon leaving the hot area or contamination reduction area.

3. All field personnel will shower (including washing the hair) immediately after decontamination procedures.

4. All field personnel wearing a respirator must shave to insure a proper fit.

5. Contact (personal or equipment) with potentially contaminated substances should be avoided. Do not walk through standing water or mud, and avoid kneeling on ground. All instruments should be placed on polyethylene sheeting.

3.6 EMERGENCY PROCEDURES

3.6.1 Local Emergency Resources

The following local emergency resources are located in the vicinity of Midway Landfill:

- Kent Police Department - (206) 872-3313
- Kent Fire Department - (206) 872-3322
- Paramedics, ambulances - 911
- Valley Medical Center - (206) 228-3450
- Auburn General Hospital - (206) 833-7711

The following offices should be contacted in the event of personnel exposure to hazardous substances:

- EPA Regional Safety Officer (Mr. Ronald Blair) - (206) 442-0370
- EPA Emergency Response Team - (206) 321-6660
- National Response Center - (800) 424-8802
- Chemtrec - (800) 424-9300

In the event of high pressure gas venting, the Kent Fire Department will be called via contact number. They will respond to the scene with EMT's (Emergency Medical Technicians), paramedic squad, and engine to standby and assist if necessary. In the case of personnel injury, all local emergency resources will respond by dialing 911. Typical response time is 3-5 minutes for the Kent Police Department, and 5-8 minutes for the Kent Fire Department. Victim(s) will be transported to either one of the two hospitals listed above. The head of each emergency room will have been contacted prior to the drilling effort so they will already know the nature of the injury (i.e. burn or exposure to one of the landfill gas contaminants). In addition, a clipboard with the types of contaminant gases suspected to be present will be kept in the support zone at each drill site and immediately given to responding emergency personnel. In the event of a serious burn, the King County Fire Department will have the victim airlifted to the Harborview Burn Center in Seattle, Washington via army helicopter.

Emergency Routes

From site to Valley Medical Center:

Follow Pacific Highway North (take a right when exiting site) to Kent-Des Moines Road and take right. Go under I-5, through three (3) stop lights and get in left lane. Take Highway 167 exit (beneath viaduct). Stay on 167 and exit at 43rd Street. Take right at light. Immediately get in left hand lane. Valley Medical Center is on left.

From site to Auburn General Hospital:

Follow Pacific Highway North to Kent-Des Moines Road and take right. Get on I-5 South and exit at the Auburn exit immediately after the second Federal Way exit (Highway 18). Take left and follow 18 for 3-5 miles. Take left at C Street. At the third stop light take right and take next right. Hospital is there.

Prior to field activities, these routes will be driven to determine the closest facility and to ensure that field personnel will be familiar with the directions.

Appendix A

Level A personal protection equipment items are as follows:

1. Positive pressure SCBA (MSHA/NIOSH approved) operated in the positive pressure mode.

2. Totally encapsulating suit, boots and gloves attached.

3. Coveralls (under suite).

4. Gloves - outer, chemical-resistant. Depending on suit construction, worn over suit gloves. May be replaced with tight-fitting, chemical-resistant gloves worn inside suit gloves.

5. Gloves - inner, tight-fitting, chemical-resistant.

6. Boots - chemical-protective, steel toe and shank. Depending on suit boot construction, worn over suit boot.

7. Underwear - cotton.

8. Hard hat (optional).

10. Two-way radio communications (optional).

Level B personal protection equipment items are as follows:

1. Positive pressure SCBA (MSHA/NIOSH approved), operated in the positive pressure mode.

2. Hooded, two-piece chemical-resistant suit.

3. Gloves - outer, chemical-protective.

4. Gloves - inner, tight-fitting, chemical-resistant.

5. Boots - outer, chemical-protective, heavy rubber disposables.

6. Boots - inner, chemical-protective, steel toe and shank.

7. Two-way radio communications (optional).

8. Hard hat (optional).

Level C personal protective equipment includes the following items:

1. Fullface, air-purifying respirator (MSHA/ NIOSH approved).

2. Chemical-resistant clothing.

3. Overalls and long-sleeved jacket or coveralls; hooded two-piece chemical splash suit (when applicable - hooded disposable coveralls) (optional).

4. Gloves - outer, chemical-protective.

5. Gloves - inner, tight-fitting, chemical-resistant type.

6. Cloth coveralls - fire resistant (inside chemical-protective clothing) (optional).

7. Escape mask.

8. Hard hat (optional) - face shield (optional).

9. Boots - outer, chemical-protective heavy rubber disposable.

10. Boots - inner, chemical-protective, steel toe and shank.

11. Two-way radio communications (optional).

Level D equipment includes the following:

1. Coveralls - fire resistant.

2. Boots/Shoes - safety or chemical-resistant steel-toed boots.

3. Boots - outer, chemical-protective heavy rubber disposable.

4. Escape mask.

5. Safety glasses or safety goggles.

6. Hard hat (optional) - face shield (optional).

7. Gloves (optional).

17.10 APPENDIX J

METHODS FOR STATISTICAL EVALUATION OF DATA

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17.10 METHODS FOR STATISTICAL EVALUATION OF DATA

The statistical outcome of a field sampling analysis program cannot be fully determined before sampling and analysis. However, accuracy and precision targets can be established as part of the QA Project Plan. Methods for ensuring completeness, representativeness, and comparability can then be derived from accuracy and precision targets.

The success of sampling and laboratory test programs can be compared with the targets established during preprogram sampling. Targets are established as a general guideline for quality assurance. Quantitative targets for accuracy and precision must be established with the knowledge that such targets are only estimates. Real world samples are subject to imprecision and bias from a number of sources, such as high ionic background, interfering constituents, and preanalysis handling errors, during the preconcentration, interference removal, solids separation, and dilution steps.

The following techniques for establishing precision and accuracy should be implemented only after considering how this information will be used to advance the project objectives. To ensure that useful quality control information is produced, careful planning, preparation, and field team training are necessary. The development of statistically related QA targets should be balanced with the cost and level of effort that is necessary to meet the project objectives.

The QA targets for statistical treatment of data are stated in terms of the standard error (see equation [2] below) and are stated in terms of expected range of uncertainty and a level of confidence. These methods apply to a individual medium within a project site; however, the discussion will not further address that fact.

17.10.1 Measurement Bias

Accuracy is a measure of the agreement of a reported chemical test result with the true concentration in the sample. Direct knowledge of the true concentration of a constituent in a legitimate field sample is not available independently of sample analysis (with its intrinsic uncertainty). Estimates of the measurement bias are possible, however, if a field sample is split into two parts and one is spiked with a known amount of the constituent of interest.

The measurement bias of analysis can be inferred from the recovery as determined by sample spiking:

$$\text{Recovery} = \frac{\Delta C}{C_s} \times 100, \qquad [1]$$

where ΔC is the measured concentration increase due to spiking (relative to the unspiked concentration) and

C_s is the known added concentration increase in the spike.

For C equal to zero, the recovery would be 100 percent.

Knowledge of measurement bias is useful in two ways:

- o To evaluate or select from alternative chemical analysis procedures.
- o To determine what corrective adjustments to laboratory test results should be made when the information is used in decision making.

Two pieces of information are required to estimate how many samples should be split and spiked to ensure that the targeted standard error is met (that is, the average recovery lies within the specified range at the desired confidence level):

- o The standard deviation that would be found in multiple determinations of recovery.
- o A relationship that shows how the uncertainty in the recovery decreases as the number of sample splitting and spiking events increases.

Although the standard deviation of the recovery cannot be known for actual sample collection and analysis activities at a particular location, a set of optimistic standard deviations in the recovery has been compiled from the EPA analytical procedures, Table J-1. These standard deviations are very optimistic because they are usually based on synthetic samples and because only a small number of replications were used in many instances. These are provided for project planning purposes only.

The relationship between the uncertainty in the accuracy and the number of samples split and spiked is:

$$R = t\sigma/\sqrt{n} = C\sigma, \qquad [2]$$

where R is the range of uncertainty at a given confidence),
t is the value of the t distribution for the selected (or required) confidence level (often the 90 percent confidence level) and [n-1] degrees of freedom;
C is the "range coefficient" ($t/\sqrt{n}$), n is the number of degrees of freedom (number of samples that have been split and spiked), and
σ is the standard deviation (the actual standard deviation for a representative set of samples, if known, one chosen by a chemist, or the optimistic standard deviation from Table J-1, if not otherwise known).

It is preferable to have samples split into two portions, and one portion spiked with a known amount of a constituent must be done in the field before the samples are processed by a laboratory (rather than being done in the laboratory). Spiking by the field investigation team eliminates inadvertent bias that might be introduced by laboratory personnel through special handling or care in the analysis. It is often necessary, however, to avoid extensive sampling manipulation in the field because of the lack of proper facilities.

When field spiking is not feasible, it may be necessary to perform "semi-blind" spiking.

To do this, split the requisite number of samples but defer spikes until laboratory analyses of the unspiked portions have been performed and reported. When spiking the corresponding half of each split pair,

Table J-1

REPORTED ACCURACY, PRECISION, AND OPTIMUM CONCENTRATION RANGES UNDER IDEAL CONDITIONS

Measurement Parameter (Method)	Reference	Accuracy	Precision (relative deviation)	Optimum Concentration Range	Comments
Metals					
Antimony (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 96% to 97% (σ=0.707%)	±0.0067 to ±0.016	1 to 40 mg/l	Mixed industrial domestic waste
Antimony (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979			20 to 300 µg/l	
Arsenic (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979	Recoveries, 85% to 90% (σ=2.52%)	±0.054 to ±0.088	5 to 100 µg/l	Mixed industrial waste spiked with As
		Recoveries, 101% to 106% (σ=2.64%)	±0.016 to ±0.035		Spiked tap water
Arsenic (atomic absorp.-gaseous hydride)	EPA-600-4-79-020 March 1979	Recoveries, 85% to 94% (σ=4.93%)	±0.055 to ±0.09	2 to 20 µg/l	Synthetic sample
Arsenic (Spectrophot.-SDCC)	Standard Methods 15th ed., 1980, p. 174	(0% relative error for 46 laboratories)	±0.138	10 µg/l and above	Spiked distilled water sample
Beryllium (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 97% to 100% (σ=1.53%)	±0.008 to ±0.02	0.05 to 2 mg/l	Mixed industrial-domestic waste
Beryllium (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979			1 to 30 µg/l	

Table J-1

(continued)

Measurement Parameter (Method)	Reference	Accuracy	Precision (relative deviation)	Optimum Concentration Range	Comments
Cadmium (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 94.3% to 235% (calculated from bias data) (σ=54.3%)	±0.23 to ±3.57	0.05 to 2 mg/l	Spiked natural water samples with added metals
Cadmium (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979	Recoveries, 96% to 98% (σ=1.53%)	±0.032 to ±0.04	0.5 to 10 μg/l	Spiked tap water
Chromium, total (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 89.8% to 137.7% (calculated from bias data) (σ=17.75%)	±0.28 to ±1.054	0.4 to 10 mg/l	Spiked natural water samples with added metals
Chromium, total (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979	Recoveries, 97% to 102% (σ=2.64%)	±0.0042 to ±0.01	5 to 100 μg/l	Spiked tap water
Chromium, total (atomic absorp.-chelation-extraction)	EPA-600-4-79-020 March 1979			$10 μg/l and up	
Chromium, hexavalent (atomic absorp.-chelation-extraction)	EPA-600-4-79-020 March 1979	Recovery, 96% (avg.)	±0.052	$10 μg/l and up	Spiked tap water
Copper (atomic absorp-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 97.6% to 129.7% (calculated from bias data) (σ=12.07%)	±0.169 to ±0.81	0.2 to 5 mg/l	Spiked natural water samples with added metals

Table J-1

(continued)

Measurement Parameter (Method)	Reference	Accuracy	Precision (relative deviation)	Optimum Concentration Range	Comments
Copper (atomic absorp.- furnace technique)	EPA-600-4-79-020 March 1979			5 to 100 μg/l	
Lead (atomic absorp.- direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 99.8% to 125.7% (σ=9.87%)	±0.33 to ±0.88	1 to 20 mg/l	Spiked natural water sample with added metals
Lead (atomic absorp.- furnace techniques)	EPA-600-4-79-020 March 1979	Recoveries, 88% to 95% (σ=3.51%)	±0.032 to ±0.052	5 to 100 μg/l	Spiked tap water
Mercury (manual cold vapor technique)	EPA-600-4-79-020 March 1979	Recoveries, 87% to 89% (σ=1.15%)	±0.018 to ±0.46	0.2 μg/l and above	Spiked river water
	EPA-600-4-79-020 March 1979	Recoveries, 92.9% to 166% (σ=28.09%)	±0.273 to ±1.31		Mercury and organically spiked natural water
Mercury (automated cold vapor technique)	EPA-600-4-79-020 March 1979	Recoveries, 92% to 125%	±0.04 to ±0.08	0.2 to 20 μg/l	Distilled water
	EPA-600-4-79-020 March 1979	Recoveries, 87% to 117%			Spiked surface water
Mercury in sediment (manual cold vapor techniques)	EPA-600-4-79-020 March 1979	Recoveries, 94% to 97% (σ=2.12%)	±0.037 to ±0.069	0.2 to 5 μg/g	Sediment spiked with methyl mercuric chloride
Nickel (atomic absorp.- direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 93% to 100% (σ=3.51%)	±0.008 to ±0.055	0.3 to 5 mg/l	Mixed industrial-domestic waste

Table J-1

(continued)

Measurement Parameter (Method)	Reference	Accuracy	Precision (relative deviation)	Optimum Concentration Range	Comments
Nickel (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979			5 to 100 μg/l	
Selenium (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979	Recovery, 99%		5 to 100 μg/l	Spiked sewage sample
	Ibid.	Recoveries, 94% to 112%			Spiked industrial waste effluent
	EPA-600-4-79-020 March 1979	Recoveries, 92% to 100% (σ=4.16%)	±0.025 to ±0.12		Spiked tap water
Selenium (atomic absorp.-gaseous hydride)	JAWWA, 65, p. 731, Nov. 1973 per citation in: EPA-600-4-79-020 March 1979	Recoveries, 100% to 101% (σ=0.58%)	±0.11 to ±0.193	2 to 20 μg/l	Synthetic sample (?)
Silver (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979		±0.176	0.1 to 4 mg/l	Synthetic sample
Silver (atomic absorp.-furnace method)	EPA-600-4-79-020 March 1979	Recoveries, 94% to 104% (σ=5.03%)	±0.014 to ±0.018	1 to 25 μg/l	Spiked tap water
Thallium (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 98% to 100% (σ=1.15%)	±0.013 to ±0.03	1 to 20 mg/l	Spiked industrial-domestic waste water
Thallium (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979			5 to 100 μg/l	

Table J-1
(continued)

Measurement Parameter (Method)	Reference	Accuracy	Precision (relative deviation)	Optimum Concentration Range	Comments
Zinc (atomic absorp.-direct aspiration)	EPA-600-4-79-020 March 1979	Recoveries, 99.3% to 306% (σ=80.8%)	±0.34 to ±3.71	0.05 to 1 mg/l	Spiked natural water samples with added metals
Zinc (atomic absorp.-furnace technique)	EPA-600-4-79-020 March 1979		±0.005	0.2 to 4 μg/l	Acid mine waters

adjusting the spike additions so that about one-third of the sample's original concentrations are increased by 10 percent, one-third are increased by about 50 percent, and one-third are increased twofold.

For the "semi-blind" strategy, the actual number of spikes should be at least 1-1/2 times the idealized" number to provide for real world conditions and as an allowance for sample mishandling, loss, spikes that fall into the "noise level" of the sample composition, or damage in transit.

17.10.2 Precision

Precision is a measure of the scatter in repetitious determinations of a parameter. In a field sampling and analysis program, scatter in data can originate in several ways, particularly during sampling and chemical analysis.

Precision is expressed as a probability (level of confidence) that the nominal or average value of a parameter will not deviate by more than plus or minus a certain amount (the standard error) from the reported (measured or observed) value. It is implicit in such a statement that the measurement of a parameter involves some uncertainty and that there is a possibility that the reported (measured) value is not precisely the same as the nominal or average value.

The selection of the quality assurance targets for precision involves exercise of judgment concerning the following points:

- The use to which the test results will be put (litigation, remedial action decision, pollutant type identification, others).
- Budgetary and work scope authorization constraints.
- Limited availability of contract laboratory services.
- Project- and site-specific factors.

It will usually be necessary to strike a compromise among the various factors.

It is usually preferable to collect QA samples from as many diverse locations as possible in order to avoid reliance on a single sampling

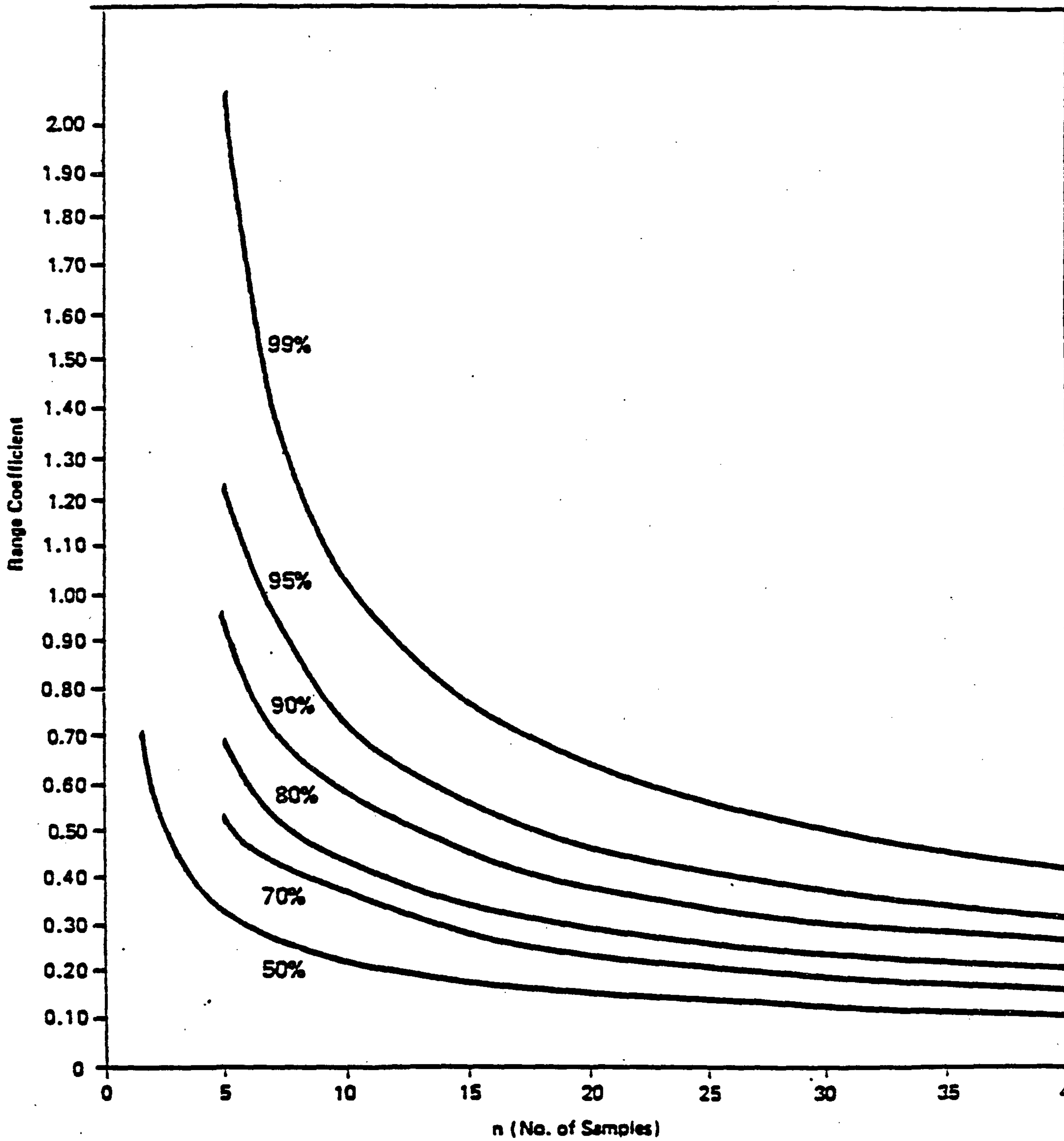

Figure J-1 Relationship Between the Number of Samples and the Range Coefficient for Selected Confidence Levels location (no useful information if all samples from a single location are below detection limits) and to permit valid comparisions to be made between various sampling locations.

For may hazardous waste sites, there may be limited information available about the types and quantities of pollutants that are present, and it may be unclear what concentration constitutes a "level of enironmental concern." In the extreme case where even the type of pollutant is unknown, it may be unnecessary to undertake a program of spiking and redundant analyses that is independent of the CLP if quanitifiction will be part of a planned subsequent phase of work.

To determine whether there is significant scatter due to sampling (in excess of that due to chemical testing), pairs of samples are collected from the same sampling location and one of the samples is split into two portions.[1] Scatter attributable to chemical testing is detected by observing the discrepancies between the two portions of the split samples. Scatter due to sampling errors is detected by looking for any greater scatter in independent paired samples that is found in the two portions of the split sample.

If, during systematic reduction of laboratory data, statistaically significant sampling error is detected, data from that sampling event may become suspect and the Project Manager should investigate whether there is any reason to discard the data (such demonstrable improper decontamination).

If on the other hand, the scatter is attributable to chemical testing, the data clusters (consisting of a pair of samples and the

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[1]It usually is convenient to split both members of a sample pair and spike one of the split portions for a total of four submittals to the laboratory from each location that is sampled for QA purposes. This provides maximum efficiency in the use of samples for determining accuracy and precision during a sampling event. Moreover, if the required number of spikes is less than the required number of pairs-and-splits, a better measure of the precision can be obtained by splitting both memebers of the pairs that do not require spikes and analyzing all four portions.

split portions of at least one member of the pair) are treated as repetitious analyses of a sample from each sampling location, giving three independent measurements for a single location (or four independent measurements in the event both members of a pair are split but none of the fractions are spiked). The individual data clusters are then examined to determine if any of them exhibit more scatter than would be expected by chance alone. The standard deviation for each of the clusters is computed, and the cluster with the largest scatter is tested with the F-ratio test to determine if its data are significantly more scattered than the other data. Clusters whose scatter is excessive may warrant re-examination.

When clusters have been validated with the F-ratio test, and overall relative standard deviation is calculated using the validated data.

17.11 APPENDIX K

AUDIT PROGRAM

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17.11 AUDIT PROGRAM

17.11.1 Scope And Purpose

The purpose of this section is to provide guidance to persons conducting project audits as part of the Quality Assurance Program.

All information produced or obtained in the course of enforcement inspections, investigations, and evaluations is potential evidence. As such, the information must be reliable, gathered with constitutional safeguards, and maintained with integrity. Potential evidence may be a field notebook, film, computer tape, a sample identification tag, or a degradable sample. Typically, a case preparation investigation can generate large volumes of file material, samples, data tabulations, and reports. Security and accountability (chain of custody) must be maintained even while the evidence is in shipment.

Uniform sample control, chain of custody, and document control procedures have been adopted using EPA's procedures as a model.

These procedures ensure the integrity of the data and related information and its security prior, during, and after any litigation takes place.

Internal audit procedures have also been developed to ensure that the information developed during investigations and evaluations conforms to EPA's requirements. These procedures were developed using the NEIC Procedures Manual for the Evidence Audit of Enforcement Investigations by Contractor Evidence Audit Teams, EPA-330/9-81-003, September 1981.

Checklists for each audit appear in the Appendix under "Standard Forms to be used."

17.11.2 Audit Procedures

17.11.2.1 Field Activities. The QAM may schedule audits of field activities at various times to evaluate the execution of sample identification, sample control, chain of custody procedures, field documentation, and sampling operations. The evaluation is based on the extent to which the applicable Sampling Plans and Standard Procedures are being followed.

The person conducting the audit is normally a senior technical reviewer who is familiar with the technical and procedural requirements of field sampling and with the applicable Sampling Plan and Standard Operating Procedures (SOP). The auditor keeps a record of his evaluation using field notes and checklists. Following the audit, he reviews preliminary results with the person in charge of the sampling. The auditor also prepares an audit report containing the results of his evaluation and recommendations for any necessary corrective actions.

Audits are scheduled with the Project Manager and the person in charge of the field sampling.

- Sample Identification Tags - The auditor examines a selected number of Sample Identification Tags for completeness and accuracy. He determines if the station number and location are identified; the date and time collected are indicated; the type of sample and analysis are specified; the preservative (if used) is identified; and the samplers' signatures appear on the tag. The tag numbers will be checked to ensure that they are the ones issued to the project. The auditor also determines if the station location accurately identifies where the sample was actually taken and if the sampling methods used were as directed by the Project Manager.

- Chain of Custody Records - The auditor selects a predetermined number of the Chain of Custody Records to be audited in the field. The records must be reviewed to determine if the station number, station description, date, and time correspond to the Sample Identification Tag; if the parameters to be analyzed have been appropriately identified; and if all custody transfers have been documented and the date and time of transfer recorded. The auditor also determines if samples are properly maintained in custody at all times and are locked up to prevent tampering. Sampling equipment is checked for security and to detect any tampering.

- Receipt for Samples Form - The auditor checks to make sure that a Receipt for Samples form is given to the owner, operator, or agent in charge of a facility or site whenever splits are provided for them, even if the offer for split samples is declined. The auditors also check to make sure that the forms are properly completed and that signatures are obtained. If signatures are not obtained, he checks the "Remarks" section of the Chain of Custody Record for the transaction to see if a signature was requested and declined.

- Traffic Forms - Organic, Inorganic, and high-hazard Traffic Reports and Special Analytical Services Request Forms prepared by field investigation teams for samples shipped to contractor laboratories also are subject to audit. The auditor ensures that the information recorded on the forms is correct and that it coincides with the information on the Sample Identification Tags and on the Chain of Custody Record.

- Field Notebooks - Field Notebooks are reviewed during the field investigation audit to see that each is signed and all entries are dated. During field investigations, notebooks are either in the possession of individuals or, for large sampling projects, are kept at each sampling station or location. The project number, EPA site number, date of receipt, and the name of the person receiving the book are usually recorded on the cover. For notebooks kept at each station, the project number and station number are usually recorded on the cover and on each page. All in situ measurements and field observations are recorded in the notebook with all pertinent information necessary to explain and reconstruct sampling operations. Each page is dated and signed by all individuals making entries on that page. The Project Manager and the field personnel on duty are responsible for ensuring that notebooks are present during all monitoring activities and are stored safely to avoid possible tampering. Any lost, damaged, or voided notebooks are reported to the Project Manager. Notebook entries must be legible, written in ink, and contain accurate and inclusive documentation of project activities. Because the notebook forms the basis for reports to be written later, it must contain only facts and observations. Language should be objective, factual, and free of personal feelings or other terminology that might prove inappropriate. Entries made by individuals other than the person to whom the notebook was assigned must be dated and signed by the individual making the entry.

Photographs may be taken for evidence and must be controlled. The auditor reviews the field notebook to determine if the photographs are properly documented. When movies, slides, or photographs are taken showing sampling sites or providing other documentation, they are numbered to correspond to the notebook entries. The name of the photographer, date, time, site location, and site description are entered sequentially in the notebook as photos are taken.

The Project Manager or Project Engineer will document the transfer of notebooks to the individuals who have been designated to perform specific tasks on the field investigation. All pertinent information should be recorded in these logbooks from the time each individual is assigned to the project until the project is completed.

The auditor will review Field Notebooks for their adherence to these procedures.

- <u>Sampling Operations</u> - The auditor reviews sampling operations to determine if they are performed as stated in the project plan or as directed by the Project Manager. The proper number of samples should be collected at the assigned locations. The auditor checks to determine that the samples are in proper containers and are properly preserved.

  He also determines if the required field measurements and quality assurance checks are being performed and documented as directed.

17.11.2.2 <u>Document Control</u>. Once a project has been completed, the individual files must be either assembled, organized, and securely stored or returned to EPA. The QAM may schedule audits of project files.

The document control audit consists of checking each document submitted for accountability. All documents used for field investigations are checked against the list of field documents issued to the Project Manager or his designated person. Written explanations must be present for any unaccounted documents. Documents other than those issued are reviewed to ensure that they all appear on an inventory and that all documents listed on the inventory are accounted for. The auditor checks the documents for an appropriate numbering system.

The documents are examined to determine that all necessary items such as signatures, dates, and project codes are included.

The auditor examines any classified documents and determines if they are handled and stored in the proper manner.

17.12 APPENDIX L

DATA REDUCTION AND VALIDATION METHODS

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Data Reduction and Validation Methods

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17.12 DATA REDUCTION AND VALIDATION METHODS

Two criteria are used to validate and reduce chemical test data: accuracy and precision. Other considerations, such as, completeness, representativeness, and comparability, depend on accuracy and/or precision and consequently are thought of as subordinate factors (or dependent variables.)

17.12.1 Accuracy

17.12.1.1 Definition of Recovery. The accuracy of chemical test results is measured by establishing the average recovery. The recovery is determined by splitting a series of samples into two portions, spiking (adding a known quantity of the constituent of interest) one of the portions, and submitting both portions for laboratory analysis as independent samples. Recovery (expressed as a percentage) is computed from equation 1.

$$\text{Recovery} = \frac{\Delta C}{C_s} \times 100 \quad , \qquad [1]$$

where:

ΔC is the measured concentration increase due to spiking (relative to the unspiked portion).

C_s is the known concentration increase in the spike.

Perfect accuracy would be defined by 100 percent recovery.

17.12.1.2 Standard Deviation of Recovery. The uncertainty in the observed recovery is reflected in the calculation of the standard deviation in the recovery and in the correction of the standard deviation to reflect the small number of sample splitting and spiking events.

Compute the standard deviation, σ, according to the following formula:

$$\sigma = \sqrt{\frac{\sum(\text{Recovery}_i - \text{Recovery}_{avg})^2}{n - 1}} \quad , \qquad [2]$$

where n is the number of split and spiked sample pairs.

17.12.1.3 Validating Recovery Data. To validate recovery data, the individual recoveries ($Recovery_i$) are compared with the average recovery ($Recovery_{avg}$) value to identify individual values that lie outside the range of reasonableness. Chauvenet's criterion is used to identify individual recovery values that lie outside the range of reasonableness.

To use Chauvenet's criterion, the screening variable must be computed for recovery values that are suspected of laying outside the range of reasonableness.

$$\text{Screening Variable} = \left| (Recovery_i - Recovery_{avg}) / \sigma \right| . \quad [3]$$

The calculated screening variable is then compared to the maximum allowable value (Table L-1) for the appropriate number of recovery determinations. The suspect recovery value is set aside (set aside values are called "outliers") if the calculated screening variable equals or exceeds the maximum allowable value.

If outliers are identified using Chauvenet's criterion, a new average recovery and a new standard deviation are recalculated using the remaining "good" values, and Chauvenet's criterion is reapplied. This procedure is repeated until all surviving recovery values pass Chauvenet's criterion. (Usually one application and one recalculation are enough.) The final average recovery and final standard deviation are calculated from the "surviving" recovery values. The final average recovery value is used to eliminate any bias from the laboratory data.

17.12.1.4 Range of Uncertainty in the Recovery. The range of uncertainty, R, in the recovery is computed from:

$$\pm R = \pm t \cdot \sigma / \sqrt{n} , \quad [4]$$

where:

- R is the range of uncertainty expressed as percent.
- t is the value of the t distribution for the selected confidence level (usually the 90 percent confidence level) and (n - 1) degrees of freedom (Table L-2).

Table L-1
CHAUVENET'S CRITERION
FOR REJECTING A SUSPECTED VALUE[a]

Number of Samples n	Maximum Allowable Values for $(Recovery_i - Recovery_{avg}) / \sigma$ [b]
5	2.015
6	2.111
7	2.164
8	2.195
9	2.214
10	2.228
11	2.279
12	2.318
13	2.348
14	2.373
15	2.393
16	2.409
17	2.424
18	2.435
19	2.445
20	2.454
21	2.462
22	4.469
23	2.475
24	2.480
25	2.485
26	2.502
27	2.517
28	2.530
29	2.543
30	2.555
40	2.634

[a] Based on "t" distribution rather than the traditional "normal" distribution.
[b] Individual Recovery = $Recovery_i$ and Average Recovery = $Recovery_{avg}$

Table L-2
DISTRIBUTION OF t

Number of Sample	Degrees of Freedom	"Complementary" Probability (as percent)						
		50	70	80	90	95	98	99
2	1	1.000	1.963	3.078	6.314	12.706	31.821	63.657
3	2	.816	1.386	1.886	2.920	4.303	6.965	9.925
4	3	.765	1.250	1.638	2.353	3.182	4.541	5.841
5	4	.741	1.190	1.533	2.132	2.776	3.747	4.604
6	5	.727	1.156	1.476	2.015	2.571	3.365	4.032
7	6	.718	1.134	1.440	1.943	2.447	3.143	3.707
8	7	.711	1.119	1.415	1.895	2.365	2.998	3.499
9	8	.706	1.108	1.397	1.860	2.306	2.896	3.355
10	9	.703	1.100	1.383	1.833	2.262	2.821	3.250
11	10	.700	1.093	1.372	1.812	2.228	2.764	3.169
12	11	.697	1.088	1.363	1.796	2.201	2.718	3.106
13	12	.695	1.083	1.356	1.782	2.179	2.681	3.055
14	13	.694	1.079	1.350	1.771	2.160	2.650	3.012
15	14	.692	1.076	1.345	1.761	2.145	2.624	2.977
16	15	.691	1.074	1.341	1.753	2.131	2.602	2.947
17	16	.690	1.071	1.337	1.746	2.120	2.583	2.921
18	17	.689	1.069	1.333	1.740	2.110	2.567	2.898
19	18	.688	1.067	1.330	1.734	2.101	2.552	2.878
20	19	.688	1.066	1.328	1.729	2.093	2.539	2.861
21	20	.687	1.064	1.325	1.725	2.086	2.528	2.845
22	21	.686	1.063	1.323	1.721	2.080	2.518	2.831
23	22	.686	1.061	1.321	1.717	2.074	2.508	2.819
24	23	.685	1.060	1.319	1.714	2.069	2.500	2.807
25	24	.685	1.059	1.318	1.711	2.064	2.492	2.797
26	25	.684	1.058	1.316	1.708	2.060	2.485	2.787
27	26	.684	1.058	1.315	1.706	2.056	2.479	2.779
28	27	.684	1.057	1.314	1.703	2.052	2.473	2.771
29	28	.683	1.056	1.313	1.701	2.048	2.467	2.763
30	29	.683	1.055	1.311	1.699	2.045	2.462	2.756
31	30	.683	1.055	1.310	1.697	2.042	2.457	2.750
41	40	.681	1.050	1.303	1.684	2.021	2.423	2.704
61	60	.679	1.046	1.296	1.671	2.000	2.390	2.660
121	120	.677	1.041	1.289	1.658	1.980	2.358	2.617
∞	∞-1	.674	1.036	1.282	1.645	1.960	2.326	2.576

n is the number of samples that have been split.

σ is the standard deviation.

The range of uncertainty, R, is used in conjunction with the average recovery to determine if bias adjustments are required.

17.12.1.5 Correcting for Accuracy. Together, the final average recovery value and the corresponding range of uncertainty constitute the statement of accuracy for a particular sampling program. If 100 percent recovery lies outside the range of the final average recovery value ± range of uncertainty, then all test data are corrected to eliminate bias. Test data are corrected by multiplying by 100, then dividing by the final average recovery value (expressed as a percent.) If 100 percent lies within the final average recovery value ± the range of uncertainty, then no bias correction is required.

17.12.1.6 Completeness of Accuracy Data. The completeness of accuracy data is that percentage of the total number of spiked-unspiked pairs that remain after outliers are identified and set aside with Chauvenet's criterion.

17.12.2 Precision

The precision of the chemical test results is reflected in the amount of scatter that would be observed in repetitious measurements of a component in a single sample. In most sampling programs, scatter is attributable either to chemical analysis or to errors committed during sampling. Most of the time, sampling error will be small, and the principal source of scatter will be laboratory analysis.

17.12.2.1 Comparison of Sampling and Laboratory Scatter. The relative contributions of analytical error and of sampling error can be established by comparing the scatter in independent sample pairs (from the same location) with the scatter in the splits.

For each independent pair of samples (from the same location), compute the Industrial Statistic:

$$I_{pair} = \frac{2\,|A - B|}{A + B}, \qquad [5]$$

where:

A and B are the independent test results of a sample pair that should yield the same test result if the precision were perfect.

I is the Industrial Statistic for the sample pair.

Next, compute the standard deviation for the Industrial Statistics of the paired samples.

$$\sigma_{I_{pair}} = \sqrt{\frac{\sum_{i=1}^{n} (I_i - \bar{I})^2}{n - 1}} , \qquad [6]$$

where:

I_i represents the individual industrial statistics for the paired samples.

$\bar{I}$ is the average value for the industrial statistic.

n is the number of sample pairs that were tested.

The next step is to calculate the individual industrial statistic for each set of split samples.

$$J_{split} = \frac{2\,|C - D|}{C + D} , \qquad [7]$$

where:

C and D are independent test results of each member of a split sample.

The standard deviation for the split samples is the calculated:

$$\sigma_{J_{split}} = \sqrt{\frac{\sum_{i=1}^{m} (J_i - \bar{J})^2}{m - 1}} , \qquad [8]$$

where:

J_i is analogous with I_i

$\bar{J}$ is analogous with $\bar{I}$.

m is the number of samples that were split for independent duplicate analysis.

The "t" test is used to test for significant difference between $\bar{I}$ and $\bar{J}$. To use the "t" test, the value "t" must first be computed from:

$$t = \frac{\bar{I} - \bar{J}}{\left[\frac{1}{m} + \frac{1}{n}\right]^{\frac{1}{2}} \left[\frac{(\sigma_{pair})^2(n-1) + (\sigma_{split})^2(m-1)}{m + n - 2}\right]^{\frac{1}{2}}} . \qquad [9]$$

The quantity (m + n - 2) is referred to as the number of degrees of freedom. Compare the value of "t" from [9] with the value of "t" in Table L-2 for 90 percent probability and (m + n - 2) degrees of freedom.

If the value in Table L-2 is smaller than the calculated value for "t," then there is a significant difference between the paired and the split samples, and the Project Manager should investigate sampling practices, storage, shipping and handling procedures, and other aspects of the field investigation. No further statistical analysis is needed until the matter is re-examined (or the site is further investigated.)

If the value in Table L-2 is larger than the calculated value for "t," then there is no significant difference between paired samples and split portions, and statistical evaluation of the test data should continue.

17.12.2.2 Validating Data. The next step in validating the test data is to calculate the individual relative standard deviations for the sampling locations where both paired samples were collected and at least one of the pairs was split into two portions. The individual relative standard deviations are computed from:

$$(\sigma_{set})_i = \sqrt{\frac{\sum_{j=1}^{p_i} (w_j - 1)^2}{p_i - 1}} , \qquad [10]$$

where:

$(\sigma_{set})_i$ represents the relative standard deviations for each set of samples, including both the paired samples and the split fractions in the set.

w_j represents the normalized values of the individual data points in each set, calculated from $w_j = \bar{x}_j/x_i$. (x_j is the actual reported value and x_i is the average value for the pair-split data points in that set.)

p_i represents the numbers of data points in each data set. ($p_i = 3$ if only one sample of a pair is split, and $p_i = 4$ if both samples of a pair are split and none of the split portions are spiked.)

The individual relative standard deviations, $(\sigma_{set})_{i's}$, are tabulated in ascending order of their relative values, the largest value being listed last. The F-ratio test is then used to determine whether the largest $(\sigma_{set})_i$ is significantly larger than the collective relative standard deviation computed from the remaining smaller $(\sigma_{set})_i$ values. If so, then the data set from which the largest $(\sigma_{set})_i$ was computed is set aside as having a range outside the expected limits, and the test is reapplied to determine if the next largest value is significantly larger than the recomputed collective relative standard deviation.

To perform the F-ratio test, the collective relative standard deviation is computed using all but the largest $(\sigma_{set})_i$

values:

$$\sigma_{collective} = \left[\frac{(\sigma_{set})_1^2(p_1-1) + (\sigma_{set})_2^2(p_2-1) + \cdots + (\sigma_{set})_k^2(p_k-1)}{(p_1-1) + (p_2-1) + \cdots + (p_k-1)}\right]^{\frac{1}{2}}, \quad [11]$$

where all $(\sigma_{set})_i$ values are used <u>except</u> the largest.

The value of F is calculated as the square of the ratio of the largest $(\sigma_{set})_i$ to $(\sigma_{collective})$ as follows:

$$F_{calc} = \frac{(\sigma_{set})_i^2}{(\sigma_{collective})^2} \quad , \quad [12]$$

The value of Fcalc will always be greater than one.

The number of degrees of freedom for the largest individual relative standard deviation $(\sigma_{set})_i$ is (p_i-1). The numerical value for p_i-1 will usually be 2, but sometimes will be 3 (when both samples of a pair are split but not spiked). The number of degrees of freedom for $(\sigma_{collective})$ is the same as the denominator in equation [11], namely, $(p_i-1)+(p_2-1)+\cdots+(p_k-1)$, excluding the (p_i-1) corresponding to the largest individual $(\sigma_{set})_i$.

Locate in Table L-3 the number of degrees of freedom for the largest $(\sigma_{set})_i$ by reading across the top row, labeled "Degrees of Freedom for Largest $(\sigma_{set})_i$" Then read down the column beneath the degrees of freedom corresponding to $(\sigma_{set})_i$ and locate the value of F corresponding to the degrees of freedom of the smallest variance, $\sigma_{collective}$. If F_{calc} is greater than $F_{tabulated}$, then the data points used in the computation of $(\sigma_{set})_i$ should be set aside because the scatter in the chemical data is outside the range expected by chance alone.

If the data set corresponding to the largest $(\sigma_{set})_i$ is set aside, then a new $\sigma_{collective}$ should be calculated omitting $(\sigma_{set})_i$ values for the set aside data and for the next largest relative standard deviation, $(\sigma_{set})_i$. The F-ratio test is rerun to determine if $(\sigma_{set})_i$ should be set aside because of excessive scatter. Data sets are successively set aside until the largest remaining $(\sigma_{set})_i$ passes the F-ratio test.

Table L-3
DISTRIBUTION OF F AT 95 PERCENT CONFIDENCE LEVEL

Degrees of Freedom for σ^2 collective	Degrees of Freedom for Largest $(\sigma_{set})_i^2$					
	1	2	3	4	5	6
1	161.4	199.5	215.7	224.6	230.2	234.0
2	18.51	19.00	19.16	19.25	19.30	19.33
3	10.13	9.55	9.28	9.12	9.01	8.94
4	7.71	6.94	6.59	6.39	6.26	6.16
5	6.61	5.79	5.41	5.19	5.05	4.95
6	5.99	5.14	4.76	4.53	4.39	4.28
7	5.59	4.74	4.35	4.12	3.97	3.87
8	5.32	4.46	4.07	3.84	3.69	3.58
9	5.12	4.26	3.86	3.63	3.48	3.37
10	4.96	4.10	3.71	3.48	3.33	3.22
11	4.84	3.98	3.59	3.36	3.20	3.09
12	4.75	3.89	3.49	3.26	3.11	3.00
13	4.67	3.81	3.41	3.18	3.03	2.92
14	4.60	3.74	3.34	3.11	2.96	2.85
15	4.54	3.68	3.29	3.06	2.90	2.79
16	4.49	3.63	3.24	3.01	2.85	2.74
17	4.45	3.59	3.20	2.96	2.81	2.70
18	4.41	3.55	3.16	2.93	2.77	2.66
19	4.38	3.52	3.13	2.90	2.74	2.63
20	4.35	3.49	3.10	2.87	2.71	2.60
21	4.32	3.47	3.07	2.84	2.68	2.57
22	4.30	3.44	3.05	2.82	2.66	2.55
23	4.28	3.42	3.03	2.80	2.64	2.53
24	4.26	3.40	3.01	2.78	2.62	2.51
25	4.24	3.39	2.99	2.76	2.60	2.49
26	4.23	3.37	2.98	2.74	2.59	2.47
27	4.21	3.35	2.96	2.73	2.57	2.46
28	4.20	3.34	2.95	2.71	2.56	2.45
29	4.18	3.33	2.93	2.70	2.55	2.43
30	4.17	3.32	2.92	2.69	2.53	2.42
40	4.08	3.23	2.84	2.61	2.45	2.34
60	4.00	3.15	2.76	2.53	2.37	2.25
120	3.92	3.07	2.68	2.45	2.29	2.17
∞	3.84	3.00	2.60	2.37	2.21	2.10

A value of $(\sigma_{set})_i$ passes the F-ratio test if F_{calc} is less than F tabulated.

17.12.2.3 Overall Standard Deviation. The $(\sigma_{set})_i$ values that are retained after screening for excessive scatter are all used to compute the overall relative standard deviation from the relationship:

$$\sigma_{overall} = \left[\frac{(\sigma_{set})_1^2(p_1-1) + (\sigma_{set})_2^2(p_2-1) + \cdots + (\sigma_{set})_q^2(p_q-1)}{p_i - q - 1} \right]^{1/2} , \quad [13]$$

where:

- p_i gives the total number of individual chemical analysis (excluding those set aside).
- q is the number of pair/split data sets (excluding those set aside).
- $(\sigma_{set})_i$ retains the meaning given in equation 11.

17.12.2.4 Data Precision. The maximum expected uncertainty for any individual chemical test result is:

$$x \pm x \cdot t \cdot \sigma_{overall} / \sqrt{\sum p_i - q} \quad , \qquad [14]$$

where:

- p_i and q are the same as for equation 13.
- x is the reported chemical test result.
- t is the value of the "t" distribution for $(\sum p_i - q)$ degrees of freedom in Table L-2 for the 90 percent (complementary) probability level.

17.12.2.5 Completeness of Precision Data. The completeness of the precision data is interpreted as the percentage of unspiked data that remain after outliers are identified and set aside with the F-ratio test.

17.13 APPENDIX M

PROJECT WORK PLAN
FOR
GAS PROBE INSTALLATION

MIDWAY LANDFILL REMEDIAL INVESTIGATION

PROJECT WORK PLAN

GAS PROBE INSTALLATION

MIDWAY LANDFILL REMEDIAL INVESTIGATION

KENT, WASHINGTON

August 30, 1985

State of Washington
Department of Ecology
Remedial Action Division
Office of
Hazardous Substances and Air Quality

Black & Veatch
Engineers-Architects

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PROJECT WORK PLAN FOR GAS PROBE INSTALLATION

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1.0 EXECUTIVE SUMMARY

This project work plan for the installation of gas probes in the vicinity of Midway Landfill was prepared under contract number C-85075 with the State of Washington, Department of Ecology. Authorization for its production has been made under the Midway Landfill Work Assignment MDLF-2, received April 22, 1985, as amended.

This work plan establishes a scope of services to be performed with an estimated budget of $138,529 and a completion schedule of approximately 50 days after receipt of the work assignment authorization from WDOE.

1.1 INTRODUCTION

This work plan has been developed for the fast-track installation of 80 shallow gas probes and 4 deep gas probes in the vicinity surrounding Midway Landfill, Kent, Washington. The work plan contains the description of the project scope of work, schedule, team assignments, budget, and description of outputs from each task.

1.2 OBJECTIVE

The objective of this work effort is to select locations for the gas probes, install the probes, and sample the probes for the presence of methane. The probes will consist of 80 shallow (approximately 8-10 ft.) and 4 deep (approximately 100 ft.) probes in a roughly radial pattern around the landfill to further define the extent of landfill gas migration. Activities included in this work effort are listed below:

- o Development of site plan
- o Development of design drawings
- o Implementation of health & safety, quality assurance, and sampling plans

- o Drilling contractor specifications development
- o Gas probe drilling and installation
- o Methane monitoring
- o Ground survey of probe locations (subsequent to installation)
- o Report preparation
- o Project management
- o Community relations plan development and implementation

1.3 BACKGROUND

Background information relating to the Midway Landfill project has been presented in the Midway Landfill Forward Planning document. Recent developments concerning the detection of significant levels of combustile gas off-site in the vicinity of the landfill have necessitated the development of a fast-track approach to the delineation of the extent and concentration of the landfill gas plume. The City of Seattle Solid Waste Utility is planning the construction of an on-site gas collection system. The installation of the off-site gas probes will define the extent of gas migration, and also serve as performance indicators for the proposed gas collection system.

2.0 SCOPE OF WORK

The installation of the gas probes will be conducted under the auspices of CERCLA guidelines which authorize initial remedial measures to protect humans or the environment from risks such as "serious threat of fire or explosion". The information gathered from the installation of the probes will be utilized in the selection of remedial alternatives that may be required in addition to the planned installation of the gas control system.

The installation of the probes will be done under a fast-track approach in order to minimize the time from inception to actual installation of the probes. The estimated date of start-up for field activities has been targeted for September 9, 1985.

Each of the tasks associated with this work effort are described in greater detail in the following sections.

2.1 TASK 1 DEVELOPMENT OF SITE PLAN

The focus of this task will be the development of a basic site plan for the location of the probes. Because of the extremely short time frame of the work effort, existing maps will be used. A preliminary grid of probe locations has been developed and is shown as Figure 1. Location selection will be coordinated as much as possible with consultation with local utility agencies. The procurement of rights-of-way for drilling will be the responsibility of WDOE. It is anticipated that logistical considerations may require the relocation of a number of the probes in the field; such relocations will be done at the direction of the field supervisor.

2.2 TASK 2 DEVELOPMENT OF DESIGN DRAWINGS

This task will result in the completion of typical design drawings for the shallow probes and for the deep probes. Completion notes will be included.

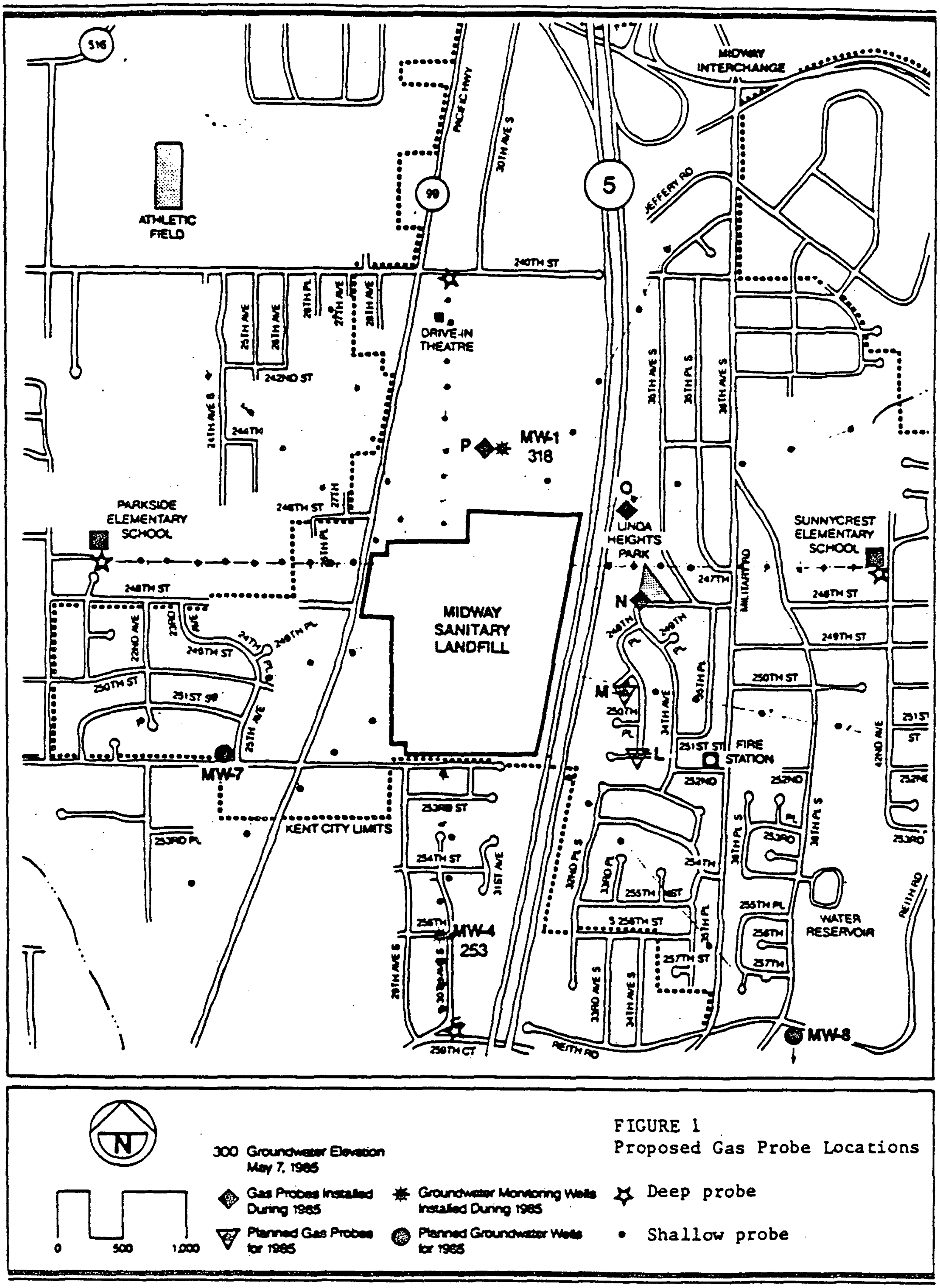

FIGURE 1
Proposed Gas Probe Locations

Deep probe

• Shallow probe

2.3 TASK 3 DEVELOPMENT OF CONTRACTOR SPECIFICATIONS

This task will be devoted to the development of the specifications for drilling and installation of the gas probes. Health and safety issues will be addressed, and compliance documentation will be required for successful bidders. Geotechnical sampling will be included in the specifications.

2.4 TASK 4 IMPLEMENTATION OF HEALTH & SAFETY, SAMPLING, AND QUALITY ASSURANCE PLANS

This task will focus on the implementation of site-specific health and safety, quality assurance/quality control, and sampling plans. Because of the short time frame for project initiation and completion, the plans may be submitted as appendices to the complete plans now in preparation for other field activities at Midway Landfill.

2.5 TASK 5 DRILLING AND INSTALLATION OF PROBES

During this task, the 80 shallow and 4 deep probes will be installed. At each of the 4 deep probe locations, 3 separate levels will be monitored, using 3 distinct casings. Resident management will be provided for field supervision of the contractor, quality assurance of the geotechnical sampling, safety supervison, and to respond to inquiries from the public. The use of magnetometers will assist in the selection of the actual drilling locations in the field. The magnetometer/metal detector will assure the avoidance of buried utility lines or other objects that may present a hazard during drilling.

2.6 TASK 6 METHANE MONITORING

During this task, combustile gas level readings will be made on each newly installed gas probe. A combustible gas indicator that produces readings in terms of percentages of the lower explosive limits (LEL) of methane in air will be used. Pressure readings will be taken to assist in determining the migration mechanism. The presence of organic compounds will be determined using an organic vapor analyzer.

2.7 TASK 7 GROUND SURVEY

The locations of the gas probes will be surveyed. The survey is expected to be conducted in conjunction with the survey of the placement of gas probes and groundwater monitoring and leachate wells at the Midway site to minimize costs. The locations will be plotted on the base map that will be developed as a part of the remedial activities at the landfill. The survey will also provide vertical control to accurately determine probe site elevations.

2.8 TASK 8 GEOTECHNICAL AND GAS MONITORING REPORTS

The output of this task will be the submission of reports describing the field activities. Locations of the probes will be noted, and the results of the geotechnical sampling and analysis will be included. Standard stratigraphic logs and lithologic descriptions will be included in the geotechnical report. The combustible gas level readings will be summarized, along with QA/QC documentation in a monitoring report.

2.9 TASK 9 PROJECT MANAGEMENT

Project management will be an on-going task throughout this proposed work effort. Management activities include (but are not limited to) the following items; management of staff assignments, meetings, preparation of monthly status reports, subcontractor supervision, and contract management activities.

2.10 TASK 10 COMMUNITY RELATIONS

A work plan-specific community relations plan will be developed and implemented, focusing on notifying residents and business owners of the necessity of probe installation and expected results. Community relations activities will be in accordance with the framework of the existing community relations plan for Midway Landfill.

082885

3.0 SCHEDULE

Completion of tasks is estimated at 50 days from work assignment authorization.

082885

4.0 PROJECT TEAM ASSIGNMENTS

Project team firms and key personnel assignments are presented below. Key personnel biographical data for project team members are contained within the Black & Veatch Technical Proposal for this program.

Washington Department of Ecology	Key Personnel	Telephone Number
Contract Officer	Rick Hall	206-459-6293
Project Manager	David Bradley	206-459-6687
Project Geologist	Mike Ruef	206-459-6304
Black & Veatch		
Program Manager	Paul B. MacRoberts	913-339-2000
Program Engineer	Mark G. Snyder	206-754-0515
Project Engineer	Wm. Gary Smith	504-926-3743
Hall & Associates		
Community Relations	Susan Hall	206-682-1828
Hart-Crowser & Assoc.		
Project Hydrogeologist	Mike Warfel	206-324-9530

5.0 MBE/WBE PLAN

The following summarizes the firms and respective participation* levels that have been estimated within this project work plan.

Minority Business Enterprises (WBE)	Participation	Work Assignment Requirement percent
Driller (projected subcontract)	31.0	9.1
Women's Business Enterprises (WBE)		
Hall & Associates	2.0	3.0

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* "Participation" is presented as a percentage of estimated project costs for the work assignment as compared with the total estimated work assignment budget, both exclusive of other direct costs.

6.0 PROJECT BUDGET

Estimated costs for this work plan and appropriate detail support are provided in the tables within this section.

6.1 PROJECT BUDGET SUMMARY

Project budget summary is presented in Table 6.1-1. Tables 6.1-2 and 6.1-3, present summary cost information for Black & Veatch's subcontractors.

6.2 DIRECT LABOR HOURS

A summary of the total direct labor hours by task and labor category is presented in Table 6.2-1. Tables 6.2-2 through 6.2-4 present direct labor hours for each firm by task and labor category.

6.3 OTHER DIRECT COSTS (ODC's)

A summary of ODC's by firm is presented in Tables 6.3.1 and 6.3-2.

17.14 APPENDIX N

SAMPLING PLAN FOR INSTALLATION OF GAS PROBES NEAR MIDWAY LANDFILL

THE SEAL OF THE STATE OF WASHINGTON 1889

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SEP 05 1985
BLACK & VEATCH

SAMPLING PLAN
for
INSTALLATION OF GAS PROBES
near
MIDWAY LANDFILL
KENT, WASHINGTON

August 30,1985

State of Washington
Department of Ecology
Office of
Hazardous Substances and Air Quality Control

Black & Veatch
Engineers-Architects

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*Expanded for easier use

1.0 INTRODUCTION

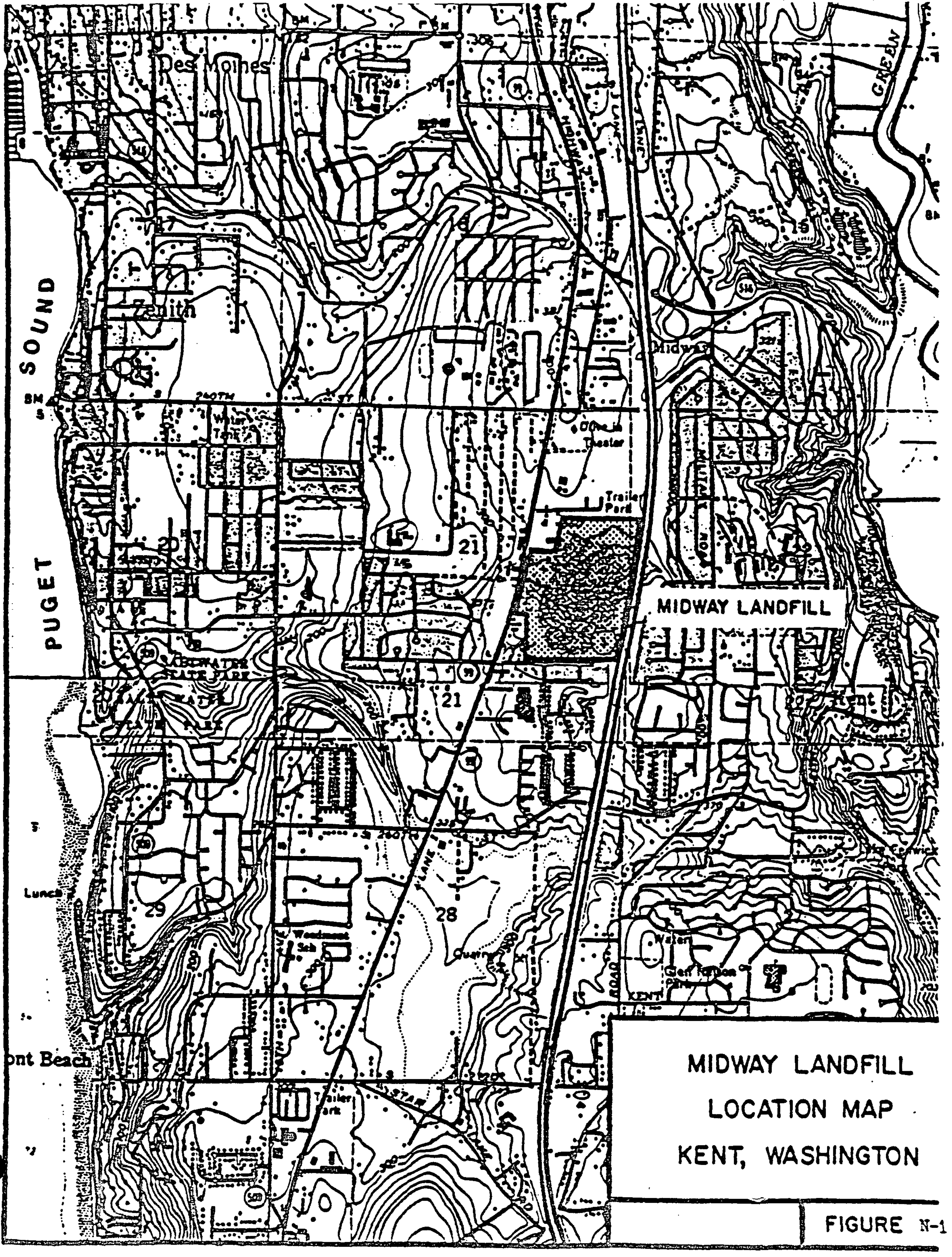
This sampling plan has been developed for the area surrounding the Midway Landfill in Kent, Washington. This sampling plan has been developed to address the fast-track installation of a number of gas probes in the area surrounding the landfill to more accurately assess the extent of the migration of landfill gases. The installation and sampling of the probes is expected to provide the information to develop an understanding of the extent of migration, as well as to serve as indicators of the effectiveness of subsequent remedial measures designed to control gas migration. Field activities for the remaining sections of the remedial investigation are described in the Sampling and Analysis Plan for Midway Landfill, September, 1985 (under preparation).

1.1 SITE LOCATION AND DESCRIPTION

The Midway Landfill is a privately owned landfill that had been operated by City of Seattle Solid Waste Utility from 1966 to 1983. The site consists of approximately 60 acres, located at South 248th and Pacific Highway South, inside the city of Kent, and is approximately 16 miles south of Seattle. The site is bordered on the east by Interstate 5. The site was formerly the location of a gravel mining operation and a peat bog lake, Lake Mead. The location and site boundaries are shown on Figure 1.

Although the facility was to be operated only as a non-putrescible landfill accepting demolition and transfer station wastes, it has been reported that unknown quantities of solvents, organic and inorganic chemicals, heavey metals, and contaminated dredge materials have been placed at Midway.

The presence of methane and other gases generated during the decomposition process of the landfill materials presents potential threats to human health and the environment at the site. Additionally, there is concern over the possible presence of organic vapors from solvents and other organic compounds allegedly disposed in the landfill.


Des Moines
Zenith
PUGET SOUND
MIDWAY LANDFILL
Midway
Kent
Woodmont Sch
Trailer Park
Quarry
Glen Nelson Park
MIDWAY LANDFILL
LOCATION MAP
KENT, WASHINGTON
FIGURE N-1

The groundwater analysis performed on the site wells indicate the presence of heavy metals and organics contamination. The presence of methane gas in the landfill and migration of methane off the property has also caused concern over safety issues for surrounding residences and businesses. Recent monitoring efforts have detected methane offsite in nearby businesses and residence at levels within the explosive range. Because of the high gas levels and resultant concern over safety issues, WDOE has supported a fast-tract approach to gas probe installation.

Currently, the Seattle Engineering Department is investigating options for closure of the site under State of Washington solid waste guidelines. As part of this effort, geotechnical and hydrological investigations were performed and alternatives for closure of the site have been developed. The Seattle Engineering Department has installed a system of methane flares and standpipes throughout the facility, as well as several boreholes for gas monitoring, and groundwater monitoring wells.

1.2 SCOPE OF FIELD ACTIVITIES

The field activities for this phase of the Remedial Investigation (installation of offsite gas probes) for Midway Landfill are described in this sampling plan. Background information relating to the site and the results of previous sampling and monitoring efforts may be found in the "Forward Planning Document for Midway Landfill", dated March 7, 1985, prepared by Black & Veatch for the State of Washington, Department of Ecology.

The following sections present a summary of the types of samples to be obtained, the numbers and locations of samples, sampling methods, and laboratory analyses. The Quality Assurance Project Plan, which describes samples handling, analytical chemistry, sample chain-of-custody, and other QA/QC procedures, will be provided as a separate document, as will be the Site Safety Plan.

2.0 FIELD ACTIVITIES

2.1 OBJECTIVES

The objectives of installation and sampling the gas probes are to:

- o Better estimate the present extent of landfill gas migration.
- o Identify migration conduits and methane accumulation points.
- o Determine the necessity of implementation of remedial safety measures (blowers, etc.)
- o Determine compositional changes in gas as it migrates away from the landfill.

2.2 EXISTING DATA

The four main sources of existing data related to subsurface gas migration are: 1) periodic methane concentration measurements made by the Seattle Engineering Department at stand pipes in the landfill and at several nearby areas, 2) weekly to bi-weekly methane concentration measurements made by Emcon and Associates at permanent gas probes outside the landfill, 3) gas composition measurements made by University of Washington personnel at three flares in the landfill (July, 1985), and 4) well logs and construction diagrams made by Golder and Associates for the permanent gas probes outside the landfill (June, 1982).

These data, especially the methane concentrations measured at the permanent probes, indicate that explosive conditions may exist in a relatively large area surrounding the landfill. Measurements of combustible gas levels both on and offsite have shown levels greater than 60 percent by volume. Although the data that are presently available do not allow the full extent of the methane plume to be estimated with any level of confidence, there are indications that the methane concentration may exceed the lower explosive limit (4 percent methane by volume) over distances greater than 1,000 feet from the landfill boundaries. Furthermore, air quality analyses performed on samples from landfill flares suggest that the gas that is migrating away from the landfill may contain hydrogen sulfide, benzene, and carbon tetrachloride in amounts exceeding the 1985 EPA threshold limit value (University of

Washington, July, 1985).

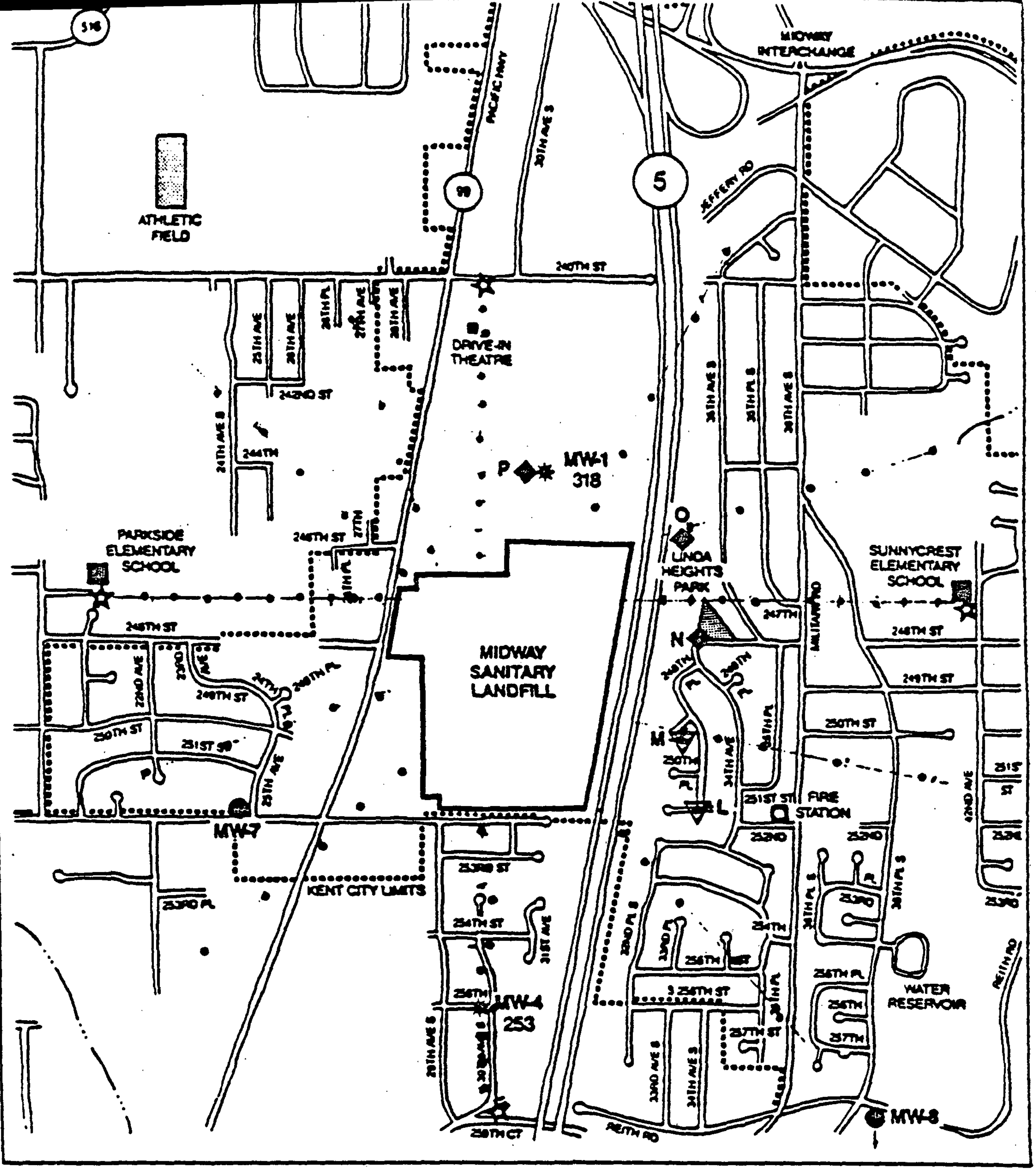
Public concern over the presence of landfill gases is high, and WDOE has supported the implementation of an intensive, fast-track program to determine the extent of the migration.

2.3 SAMPLE COLLECTION AND ANALYSIS RATIONALE

Gas probes will be installed along lines perpendicular to the landfill boundary to determine totaland partial pressure gradients away from the site. It is expected that 80 shallow (8-10 ft.) probes will be installed, as well as 4 deep probes (100 ft.). The deep probes will be placed at distal points from the landfill, and will consist of 3 probes per location completed at differing depths. The depths will be at the 40, 60, and 100' depth (approximately). The approximate locations for these probes are shown on Figure 2. The horizontal spacing between probes increases with distance away from the landfill in response to the exponential decay in gas concentrations often observed in landfills. This arrangment will also provide valuable data to be used in evaluating the effectiveness of the proposed gas control system. Gas pressure draw-down curves similar to those developed from groundwater pumping tests can be used to estimate optimal well spacings and extraction rates for the migration control system.

The holes for the probes will be drilled with a 4-inch inside diameter hollow-stem auger with split-spoon sampling at 5-foot depth intervals with samples stored for subsequent analysis (if needed).

A cluster of at least three individual probes will be installed at each of the 4 deep probe locations. The exact vertical locations for these probes will depend upon the stratigraphy that is observed at the time of installation. The monitoring probes will consist of 3/4 inch schedule 40 PVC casing with 0.02 inch slotted screening. The length of screening for the deep probes will typically range from 5 to 20 feet depending upon the stratigraphy; for the shallow probes, screening will be from 5 feet to the bottom of the probe. The deeper probes will generally have the longer screen intervals.



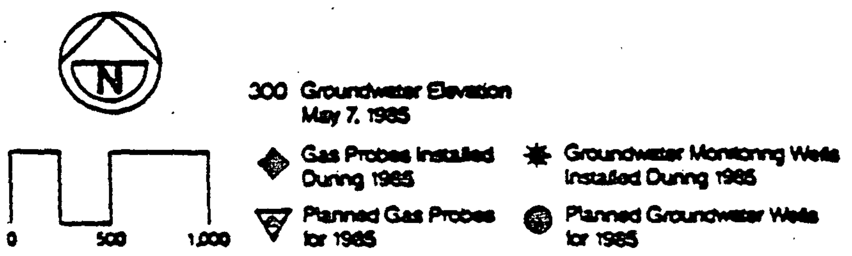


FIGURE N-2
Proposed Gas Probe Locations

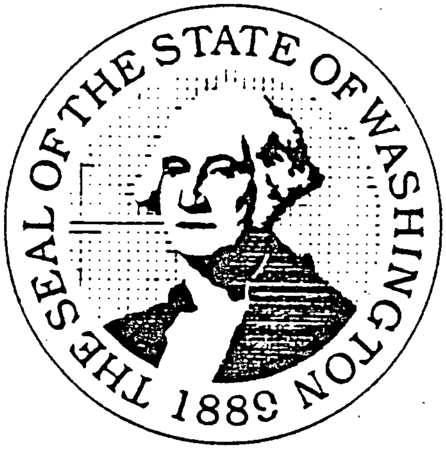
Inside the PVC casing will be 1/4 inch polyethylene tubing. This tubing will reduce the volume of gas that must be excavated to obtain a representative sample.

When the probes have been installed, measurements of total pressures, methane concentrations, and hydrogen sulfide will be made on each probe. Additionally, an organic vapor analyzer will be used to determine if organic compounds are present.

Quality control/quality assurance requirements and health and safety issues relating to the drilling, installation, and sampling of the probes are discussed under separate cover.

17.15 APPENDIX O

REMEDIAL INVESTIGATION
PROJECT WORK PLAN



REMEDIAL INVESTIGATION
PROJECT WORK PLAN

MIDWAY LANDFILL
Kent, Washington

April 4, 1986

State of Washington
Department of Ecology
Office of
Hazardous Substances and Air Quality Control

Black & Veatch
Engineers-Architects

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N/I - Not Included in this submittal.

1.0 INTRODUCTION

This revised draft project work plan for the implementation of remedial investigation (RI) activities at Midway Landfill was prepared under contract C-85075 with the State of Washington, Department of Ecology. Authorization for the production of this work plan has been made under Midway Landfill work assignment MDLF-2, as amended.

The primary objective of the work outlined herein is to develop the necessary information from investigation activities which will support the selection and development of remedial action alternatives for Midway Landfill in accordance with CERCLA RI guidelines (EPA/SAO/G-85/002, June 1985). The strategy utilized to develop this work plan is consistent with the Midway Landfill Forward Planning Document (Black & Veatch, March 1985) and the revised final RI Sampling and Analysis Plan (Black & Veatch, April, 1986).

This work plan establishes a scope of services to be performed with an estimated budget as outlined in Section 6.0 and a completion schedule as presented in Section 3.0. Project tasks include the field investigation phase of the remedial investigation and development of a remedial action feasibility study (FS) project work plan. Data obtained during remedial investigation field activities will be evaluated and a assessment made by Ecology and the project team as to whether additional RI field activities are required prior to completing the feasibility study.

1.1 INTRODUCTION

The project work plan presented herein includes the description of the project scope of work and schedule. The nature of this submittal is as a working document for use by Ecology staff, thus, the team assignments, MBE/WBE plan, and budget for completion of project tasks has been omitted.

1.2 PURPOSE AND SCOPE

The purpose of this field investigation phase of the remedial investigation is to obtain sufficient data to identify the magnitude and extent of contaminant and gas migration for assessment of remedial action alternatives during the feasibility study. The collection and review of all data will be done in a legally defensible manner in accordance with RI CERCLA guidelines and the Quality Assurance Project Plan (QAPP). The investigation will consist of activities to be conducted in four major areas: geologic investigations, hydrologic investigations, gas migration and air quality investigations, and an investigation to identify receptors. In addition, a remedial action feasibility study work plan will be developed as a result of the data accumulated and analyzed during RI field investigations. The feasibility study work plan will address each of the identified problems at the Midway site which may require implementation of additional remedial actions. The estimated date of startup for the activities described herein is May, 1986.

1.3 OBJECTIVE

The technical objectives of the work effort described in this RI Project Work Plan are as follows:

- o Define subsurface stratigraphy and geohydrology at the Midway Landfill site and surrounding area.
- o Define the nature and extent of water, air, and soils contamination at and adjacent to the Midway Landfill site to support a subsequent remedial action feasibility study.
- o Further define the nature and extent of landfill gas subsurface migration adjacent to the Midway Landfill site in support of current Initial Remedial Measures (IRM'S) and ongoing gas migration investigations.
- o Further define the characteristics of, and public health risks associated with, point source and diffuse gas emissions into ambient air at the Midway site.
- o Expand on the existing technical data included in the proposed City of Seattle final closure plan for Midway Landfill.
- o Complete identification of potential offsite contamination receptors on the Midway Landfill site and surrounding area.
- o Develop a feasibility study work plan, based on the results of field investigations, to address the development and selection of additional remedial action alternatives.

1.4 BACKGROUND

Detailed background information relating to the Midway Landfill project has been presented in the Midway Landfill Forward Planning document (Black & Veatch, March, 1985). Recent developments concerning the detection of significant levels of combustible gas offsite in the vicinity of the landfill have contributed to increased monitoring efforts, including the installation of offsite gas probes and gas extraction systems to further define the extent and concentration of the landfill gas plume and to provide control of gas emissions. The City of Seattle Solid Waste Utility has installed an onsite gas collection system and offsite gas extraction systems, and has prepared a proposed closure plan for the Midway Landfill site (Draft Environmental Impact Statement for Midway Landfill Closure, City of Seattle Engineering Department, August, 1985).

Prior to initiation of this work plan, a series of initial RI field investigations and initial remedial measures (IRM's) have been conducted at the Midway site by the Department of Ecology. These activities have addressed offsite shallow gas migration problems and have included (1) installation of 73 offsite shallow gas monitoring probes, (2) installation of 11 deep multiple gas probe clusters, (3) installation of two offsite gas extraction well systems, (4) gas monitoring and gas migration evaluations, and (5) gas characteristics investigations. Additional gas migration field investigations and evaluation tasks are currently being implemented under a separate work assignment. These efforts will include additional gas probe installations and gas monitoring, initial gas migration modeling, initial evaluation of the onsite gas control system, and additional gas characterization. These activities have and will continue to parallel similar complementary investigations being conducted by the City of Seattle at the Midway site. Work efforts completed under this work plan will complement those earlier efforts.

2.0 SCOPE OF WORK

The description of tasks required to complete the remedial investigation is detailed in the following sections. The corresponding schedule of activities is presented in Section 3.0.

2.1 TASK 1.0 PROJECT INITIATION ACTIVITIES

The purpose of this task will be the mobilization of manpower and material resources for all subsequent field activities. A base map of the landfill and surrounding area to be investigated during the RI field activities has been prepared from recently obtained WDOT aerial photography. Final locations for all drilling and other field installation activity sites will be reviewed with Ecology staff and documented on the base map. Acquisition of access for drilling and sampling of offsite gas probes and monitor wells will be the responsibility of the Department of Ecology. Location of utilities at each activity location will be the responsibility of the field activities project team. Preparations for field drilling and sampling activities will include:

(1) Project initiation meeting involving the program engineer, project engineer, site manager, geotechnical and surface monitoring task leaders, other key field project team staff, and Ecology management and technical staff.

(2) Finalization of remedial investigation Sampling and Analysis Plan site plan showing proposed drilling locations and meteorological/air quality installation locations in detail on base map.

(3) Review of final site plan by involved agencies (Ecology, WDOT, City of Kent, City of Des Moines, City of Seattle, King County, home/business owners) to identify and resolve potential problems with access to sites and other administrative concerns.

(4) Obtain Ecology approval of the final site plan from comments received during previous steps. Acquire applicable permits.

(5) Staking of approved drilling sites for gas probes, leachate wells, and groundwater monitoring wells, and arranging for marking of utility locations at offsite locations.

(6) Preparation for implementation of health and safety, quality assurance, and sampling plans, including mobilization of equipment, calibration of

monitoring equipment, laboratory coordination for scheduling of sample shipment and analyses , and any necessary site specific safety instructions for field personnel in accordance with Health and Safety Plan requirements.

Access to some offsite monitoring well and gas probe locations may take longer to arrange due to physical barriers or legal considerations. Resolution of problems at difficult activity locations or those with poor access will be an on-going process under direction of Ecology and RI project team staff.

The project initiation meeting will serve the purpose of finalizing the schedule for field activities and completing organization of the project team prior to the field and monitoring activities. Key Ecology and project team staff will conduct a site visit with the purpose of finalizing field activity locations and marking those locations on the base map.

2.2 TASK 2.0 FIELD ACTIVITIES

Remedial Investigation (RI) field activities will include those tasks which involve a one-time or uniquely identified task. The field activities described in this section typically will not include intensive monitoring programs (described in Section 2.3). Field activities that will take place at Midway Landfill are described below and in the revised final RI Sampling and Analysis Plan (Black & Veatch, April, 1986).

Organization of field activities will be the responsibility of a geotechnical site manager and a surface activities site manager. The project engineer will provide overall technical and schedule guidance to site managers. Health and safety (H&S) and quality assurance (QA) functions will be the responsibility of a single full-time H&S/QA officer who will work independently of other personnel and will insure that all field activities are in accordance with the site Health and Safety Plan and the Quality Assurance Plan. The site managers and H&S/QA officer will be assisted by staff engineers and scientists from the manpower resources of the field activities project team and specialty subcontractors.

Scheduling of field activities will be a critical project management task during work plan implementation. Scheduling of activities will be the responsibility of the project engineer and will be conducted in accordance with the overall RI Project Work Plan schedule and guidance from Ecology managers.

2.2.1. TASK 2.1 GROUNDWATER MONITOR WELL INSTALLATION

It is anticipated that a total of seventeen new monitor wells will be installed at locations within and adjacent to the landfill. In order to determine if significant differences exist in the water quality between the upper water table and the water beneath the confining layer, seven of the wells will be dual completion wells. Additionally, ten of the wells will have gas probes within the well borehole. The location of the wells has been tentatively identified in the revised final Midway Landfill Sampling Plan. Sufficient geologic samples will be obtained during drilling to characterize the subsurface stratigraphy. A priority order for installation of monitor wells has been established to obtain critical geologic and hydrogeologic data as early as possible after initiation of drilling activities. The locations and completion depth of lower priority monitor wells will be modified if necessary to insure that an optimum network of monitor wells is established adjacent to the landfill site. Additional wells may be needed if the above described wells are inadequate to meet RI objectives and satisfy feasibility study data needs.

A full-time geotechnical engineer will provide field supervision of the drilling activities and will review and certify the drillers' record. The geotechnical engineer will be responsible for consulting as required during the subsurface exploration program with the local utility locator service to avoid water, sewer, telephone, power, and other buried utilities. The geotechnical engineer will also be responsible for determining the final depth of well completion, based upon the geological characteristics and relative degree of saturation of the formations. Additionally, the geotechnical engineer will be responsible for the proper installation, grouting, and completion of the casings, screens, gravel packs, and other fill materials. Upon completion of installation of well casings, the wells will be developed. Development will occur after the water level has reached and remained at equilibrium for at least three days. At that time, the well will be purged, evacuating at least five well volumes. The process will be repeated prior to sampling. Dedicated bladder-type pumps will be installed at each wellhead for each well, with locking caps.

In addition to the geotechnical engineer, there will be assigned a field supervisor responsible for the implementation of the Health and Safety and QA Plans. This person will be designated as the H&S/QA officer, and will be responsible for the proper calibration, maintenance, and operation of all field instrumentation, as well as the proper handling of all media environmental samples. In the event that unsafe conditions arise that cannot be mitigated using measures outlined in the Health and Safety Plan, the H&S/QA officer will have authority to halt or interrupt drilling activities.

2.2.2 TASK 2.2 LEACHATE WELL INSTALLATION

This task will focus on the drilling and installation of three leachate monitor wells that will be installed within the landfill material. This task has been designated as a work effort separate from the installation of the groundwater monitor wells because of potentially greater safety risks, and different drilling and installation techniques. The presence of high levels of landfill gas, potentially under significant pressures, necessitates the provision of additional safety measures such as supplied air and SCBA equipment. Each leachate borehole will be drilled to a depth below the bottom of the fill sufficient to characterize underlying till and advance outwash deposits. Geologic samples will be taken from the fill and the zone below the fill, at 5-foot intervals, or as directed by the geotechnical engineer. Borings below the fill material will be developed and grouted using appropriate techniques to insure that the boreholes do not provide a conduit for leachate to migrate downward.

The geotechnical engineer will provide supervision of the leachate well drilling and installation. The H&S/QA officer will assume the responsibility for H&S/QA functions, and will be onsite at all times when drilling or installation of leachate monitor wells is underway. The H&S/QA officer will have complete authority to shut down or interrupt drilling operations should unsafe conditions arise that cannot be mitigated with those measures outlined in the Health and Safety plan.

Once the leachate monitor wells are installed, development tests will be conducted to purge the wells and prepare them for later sampling. At least one of the leachate wells will be installed with a 4-inch or larger casing to accomodate larger leachate pumps for greater water removal rates. Drawdown tests may be conducted at a later date using this well and appropriate surrounding gas control system extraction wells or additional leachate monitor wells to estimate a typical drawdown curve for the fill material. Permeability and transmissivity factors would be estimated for the fill using this data. This data base would be used if appropriate in developing leachate removal rates for leachate treatment alternatives during the subsequent feasibility study. Completion of this task will be contingent upon whether satisfactory water level data can be obtained from surrounding gas extraction wells or additional leachate monitor wells.

2.2.3. TASK 2.3 GAS PROBE INSTALLATION

During this task, at least six gas probe clusters will be installed adjacent to the landfill area. Gas probe locations will be selected to complement the data obtained from the initial installation of 73 shallow gas probes and 11 deep gas probe clusters which have been implemented under a separate work plan, additional gas probe clusters which are currently planned for installation under a separate work assignment, and the location of similar probe clusters installed by the City of Seattle. Locations will be finalized by the geotechnical site manager in consultation with landfill gas experts assigned to the field activities project team and Ecology project managers during project initiation activities. The securing of rights-of-way for offsite probe installation will be the responsibility of Ecology. Probes will consist of two or three clustered probes per location to assess the extent of gas migration with depth and stratigraphy.

In addition to gas probe clusters, gas probes will be installed in the same borehole with groundwater monitor wells in some locations where both types of data are needed. Gas probes will be screened above the highest saturated zone water table at these locations and will function in the same way as other gas probe clusters. Two probes will be the maximum number of installations in these boreholes to minimize the potential for seal failures between the screened probe elevations or between the probes and groundwater monitoring well screen elevations. It is anticipated that ten monitor well installations will include gas probe installations of this type.

During drilling and installation of the gas probes, the geotechnical site manager will provide drilling supervision and will be responsible for geotechnical sample collection, drilling procedures, installation procedures, and gas probe completion. The geotechnical site manager will be assisted by a landfill gas expert who will be responsible for selecting final probe depths and other decisions related to optimization of the subsequent gas probe monitoring program. The H&S/QA officer will be responsible for Health and Safety and Quality Assurance activities associated with gas probe drilling and installation.

2.2.4 TASK 2.4 GROUND SURVEY

During this task, the locations and elevations of all newly installed groundwater monitor wells, leachate wells, gas probes, and leachate seep sampling sites will be surveyed. Additionally, this work effort will encompass the surveying of existing gas probes not included in a currently planned ground survey under a separate work plan, and operable monitor wells, extraction wells, and gas probes installed under the direction of the City of Seattle. The surveying of all sample locations is necessary to accurately document their location in accordance with CERCLA guidelines, and to provide information to be used in the design of remedial action alternatives during a subsequent feasibility study. It is expected that one subcontract survey crew will be used to complete the field portion of this task. Survey computations and plotting of locations and elevations on base maps will be based on field survey notes.

2.2.5 TASK 2.5 SURFACE WATER INVESTIGATION

During this task, storm water sampling instrumentation will be installed at two locations as indicated in the revised final RI sampling Plan. Two automated storm-triggered stormwater samplers will be installed, along with continuous flow recorders to obtain a data base for I-5 inflow into the base of the landfill. A detailed storm sewer review will be conducted for the vicinity surrounding the landfill to accurately determine storm sewer drainage patterns from available storm sewer maps and to document flow conditions after rainfall events. Staff gages will be installed at the north and middle ponds on the landfill site. The locations of surface seeps in the study area surrounding the landfill will be documented and mapped for subsequent sampling and water level measurements.

2.2.6 TASK 2.6 METEOROLOGICAL/AIR QUALITY STATION INSTALLATION

Two on-site meteorological/air quality stations will be installed during this task, and three offsite satellite station locations will be identified for subsequent station installation. The two onsite stations will consist of (1) a master meteorological station which continuously records wind direction and velocity, barometric pressure, dry and wet bulb temperatures, precipitation and pan evaporation, and (2) a satellite station which records only wind direction and velocity. Both stations will be equipped with programmable air quality sampling stations consisting of a programmable portable computer, air sampling pump, and Tenax resin/activated carbon gas collection tubes. Installation will be completed as quickly as possible after field activities are initiated in accordance with the detailed site plan. The information gathered from the stations will assist in planning day-to-day field activities, by providing information concerning wind speed and direction, relative humidity, barometric pressure, temperature, rainfall, and evaporation rates. These stations will also be used to obtain event-driven onsite air quality data during the field activity period. The stations will be installed at locations to be determined by the site manager, with advice from project team and subcontractor meteorological and air quality experts. A specialty subcontractor may be retained to assist in identification of station locations. The subcontractor will install, test, and start up the instrumentation and provide consultation during the field investigation and monitoring period.

An additional satellite meteorological/air quality station, identical to the on-site satellite station, will be installed at three locations in a sequential manner to obtain offsite meteorological/air quality data in accordance with the overall air quality investigation monitoring plan. These locations will be to the east, south, and west of the landfill site and will be selected during detailed site planning activities.

Data obtained from meteorological and air quality instruments will be used to assess both on-site and offsite air quality.

2.2.7 TASK 2.7 RECEPTOR INVESTIGATION

The identification of potential receptors will be completed during this task. Receptors are defined as those human and other environmental populations on and adjacent to the landfill which may be detrimentally affected by environmental problems created by the presence of the landfill including gas migration, groundwater or surface water contamination, soil contamination, or air quality contamination. Included in this work effort will be a detailed water well survey to determine if there are any operational wells that are at risk from groundwater contamination, and a review of planning documents from the cities of Kent and Des Moines, and Seattle/King County to determine future development plans. A review of the vegetation and wildlife inventories included in the City of Seattle Environmental Impact Statement for Closure, Midway Landfill will be made. Results obtained from the combustible gas monitoring efforts currently underway will be used to profile the size and distribution of the population at risk from landfill gas presence. Potential risks to receptors will be reviewed synoptically by preparing geographic distribution maps of problem issues and overlaying these on the study area base map.

2.3 TASK 3.0 MONITORING ACTIVITIES

An intensive monitoring effort will be undertaken in conjunction with the subsurface exploration and equipment installation tasks and other field activities conducted at the Midway Landfill site. The monitoring program will be conducted on a schedule which is intended to provide time correlated data for multi-media environments, with an objective of providing basic RI-related information on the hydrologic cycle, climatic and air quality cycle, groundwater hydrology, leachate movement, and gas migration dynamics related to the Midway Landfill site.

During this work effort, monitoring of newly installed groundwater and leachate monitor wells, gas probes, and air quality will be conducted. Additionally, existing wells and probes will be sampled, as well as surface water quality. The monitoring efforts are further described below.

2.3.1 TASK 3.1 GROUNDWATER AND LEACHATE WELL MONITORING

The groundwater and leachate monitor wells will be sampled a minimum of four times during the RI monitoring period. Details of the groundwater and leachate monitoring program are included in the revised final RI Sampling and Analysis Plan. Water level measurements at all existing and newly installed wells will be made monthly during the RI monitoring period using an electronic well level indicator. Each of the newly installed wells will be sampled, as will selected onsite and offsite groundwater and leachate monitor wells. It is anticipated that at least two offsite , privately owned wells will also be sampled during this work effort. Scheduling of sampling events has been tentatively established so that all newly installed wells can be monitored and sampled at least four times during the 52 week total project period. A two-member team will be assigned to obtain the samples, with one team member devoted to sample handling (preparation of sample containers as appropriate, filling of containers, completion of chain of custody forms, packing and shipping). The other team member will be responsible for purging of the wells and actual sample procurement, and in-situ parameter measurement as outlined in the sampling plan. The site H&S/QA officer will oversee this activity to insure that all provisions of the Health and Safety and Quality Assurance Plans are followed.

2.3.2 TASK 3.2 GAS PROBE MONITORING

RI gas probe monitoring will be conducted as a continuation of the monitoring effort currently planned under a separate work assignment. That work assignment will include weekly monitoring of selected existing shallow and deep gas probe clusters installed by Ecology and the City of Seattle for a period of approximately twelve weeks. This task involves sampling all new gas probe clusters, monitor well gas probes installed under this work plan, selected shallow probes, and 10 to 20 deep gas probe clusters installed under separate Midway Landfill work plans. Selected probes installed in and near the landfill in 1985 by the City of Seattle, Solid Waste Utility will also be sampled.

Sequential monitoring rounds will begin immediately after completion of probe installation with a complete scan of all newly installed probes. Weekly monitoring of approximately 50 percent of all probes will then follow. Gas probe monitoring schedule will be flexible after three weekly rounds of monitoring are completed. Data collection is expected to include (1) intensive monitoring surveys (several measurements in a 24 to 48 hour period) for a small number of probes, and (2) time-sequenced monitoring rounds for all or most probes in general areas to the east, south, and west of the landfill. It is anticipated that gas migration modeling currently planned under a separate work assignment will generate the need for additional data collection which cannot be detailed at this time. Monitoring program modifications will be made via written memoranda generated by the Site Manager and approved by the project engineer and Ecology project manager.

Monitoring will include gas pressure and temperature, combustible gas concentration, O2 level, CO2 level, H2S level, and volatile organics, as detailed in the revised final RI Sampling and Analysis Plan. Volatile organics will be measured using a portable OVA GC/FID in (1) scan mode which provides a measurement of total VOC's, and (2) semi-quantitative mode which provides a chromatogram of the individual VOC components. Additonal VOC verification including compound identity and concentration will be provided by gas sampling and laboratory GC/FID or GC/MS confirmation.

The equivalent of five additional monitoring rounds of all installed gas probes will be completed during the RI monitoring period. Gas probe monitoring will be conducted by two one-man crews working in parallel for time-sequenced monitoring rounds involving large numbers of probes, in order to complete the rounds within a one-week period. Intensive gas monitoring rounds of a small number of probes will be completed with one two-man crew, working together or singly in 12-hour shifts over a 24 to 48 hour period. The H&S/QA officer will oversee monitoring activities to insure compliance with the H&S Plan and the QA Plan.

2.3.3 TASK 3.3 GAS EMISSION AND AMBIENT AIR MONITORING

Automated collection of meteorological and ambient air quality data will be initiated as early as possible during the RI field activities period and will be closely coordinated with other ongoing RI field activities. Air quality sampling efforts during the field activities monitoring period will be based upon the landfill gas source and ambient air monitoring work performed on-site by the University of Washington (University of Washington, July, 1985), and by the Ecology project team under an existing separate work assignment. Special attention will be given to verifying critical meteorological conditions suggested in the university researchers' report. Data will be obtained in a manner to facilitate input into the project data management system, and also will be input into the air quality dispersion model developed for the site.

An on-site automatic master weather station will be installed to collect meteorological data as early as possible during the field activities period and will continue to operate throughout the field activities monitoring period. Parameters to be measured will include wind speed and direction, dry and wet-bulb temperature, barometric pressure, rainfall, and evaporation. Sampling pumps using resin/charcoal collector tubes will be installed at upwind and downwind locations. The pumps will collect time-weighted samples under microprocessor control during meteorological event-driven monitoring periods. Real time organic vapor analyses will be conducted using a portable continuous-calibration gas chromatograph linked to the automated air sampling systems on the master and satellite meteorological stations. Organic vapor analyses will be utilized to gather data on diffuse gas emissions from the landfill surface and from the City of Seattle gas control system.

All gas emission and ambient air monitoring will be conducted under the supervision of the site manager. The site manager will be assisted by staff engineers, meteorologists, and air quality experts including subcontract staff. The H&S/QA officer will provide oversight to insure compliance with project H&S

and QA Plans.

2.3.3.1 TASK 3.3.1 GAS CONTROL SYSTEM EMISSION SOURCE MONITORING

Source monitoring of the gas control system will be conducted to determine the components of the landfill gas at the source and gas emission rate from the gas control system flare(s). The gas will be monitored at sampling ports located on the effluent side of the blower system. Physical parameters to be measured include gas flow rate, gas moisture content, and gas temperature. In addition, hydrogen sulfide, hydrogen cyanide, hydrogen chloride, carbon dioxide, oxygen, combustible gas, and representative hydrocarbons levels will be determined. The City of Seattle Engineering Department staff will be consulted to coordinate the collection of this data during normal operation of the gas control system. Similarly, the gas control system flare(s) will be sampled in an appropriate manner such that typical emissions from the flare combustion process will be monitored during both normal operation and flare-out conditions, if approved by the local air quality agency. The flare(s) will be sampled at an appropriate distance from the flame to insure complete combustion and temperatures low enough to insure proper operation of sampling equipment. Two discrete sampling events, including a full suite of field and laboratory parameters, will be conducted for the gas collection system and flare(s).

Gas control system emission source monitoring will be coordinated with other gas control system evaluations being conducted under a separate work assignment. Emissions monitoring is expected to provide verification of data obtained during an initial evaluation of the gas control system which will include calculations of flare emissions based on estimated combustion efficiency and gas composition data developed by bag sampling and laboratory GC confirmation of VOC components.

2.3.3.2 TASK 3.3.2 DIFFUSE GAS EMISSION SOURCE MONITORING

Characterization of diffuse gas emissions from the landfill surface and selected off-site locations will be accomplished using the "isolation flux" method. This method is detailed in the revised final RI Sampling and Analysis Plan. The method involves the use of a nonporous ground cover chamber designed to collect venting gas over a known surface area and to measure relevant characteristics of the gas including flow rate, temperature, and component concentrations.

It is expected that two isolation flux chambers will be used during the diffuse gas survey task, either singly or simultaneously at different locations. Diffuse gas samples will be collected at an estimated six to eight locations on the landfill site based on elevation, soil type, or other relevant criteria, with final locations to be determined during detailed site planning. At least two of the locations will represent duplicates (two devices located in the same area) to establish QA limits. An additional six to eight offsite diffuse gas survey locations will be selected based on gas migration monitoring and physiographic factors. Survey methods will be identical or similar to the on-site locations. Diffuse gas survey activities will be conducted on a schedule which is coordinated with ambient air sampling and monitoring activities.

2.3.3.3 TASK 3.3.3 GAS EMISSION MONITORING DURING SUBSURFACE EXPLORATION

Characterization of gas emissions from landfill drilling sites will be conducted as an integral part of the health and safety monitoring during drilling and leachate well installation activities. In addition to the instruments used for health and safety monitoring, the organic vapor analyzer will be used to monitor borehole gas emissions in the chromatographic mode to further characterize organic gas components. This activity will be supervised by the geotechnical site manager and conducted by the OVA instrument operator.

2.3.3.4 TASK 3.3.4 ONSITE AMBIENT AIR MONITORING

Onsite ambient air monitoring will be conducted during selected meteorological and field activity events to correlate source emissions with ambient air concentrations for selected organic compounds. Data will be collected using the automated meteorological/air quality sampling stations and a self-calibrating portable gas chromatograph linked to the stations or preset for selected conditions. Data will be collected for particular events including (1) "worst case" wind direction and velocity as predicted by the air quality dispersion model used by University of Washington researchers, (2) representative wind velocities in the easterly, southerly, and westerly directions, (3) during onsite leachate well drilling and installation activity, (4) during onsite diffuse gas emission surveys, and (5) during representative flare combustion and flare-out conditions, if appropriate. Project team members and subcontractor staff will maintain the automated monitoring equipment and collect samples as appropriate during the monitoring activity period.

2.3.3.5 TASK 3.3.5 OFF-SITE AMBIENT AIR MONITORING

Off-site ambient air monitoring will be conducted in a similar manner to the on-site monitoring activities. A satellite meteorological/air quality station will be set up offsite to the east, south, and west of the landfill in a sequential manner to collect ambient air data for three selected meteorological events. Data will be collected by the automated air sampling systems in a time-weighted manner, and simultaneously at onsite and offsite stations. Equipment will be operated and maintained as indicated above for onsite ambient air monitoring activities.

2.3.4 TASK 3.4 SURFACE WATER MONITORING

Intensive monitoring of surface water will be conducted at sites where stormwater sampling and flow monitoring devices have been installed, and at other surface water sites which may be correlated with the landfill site either through leachate seepage, potential infiltration surfaces or exfiltration conduits such as storm sewers. At least two storm events will be monitored using storm actuated flow and sampling devices installed temporarily at Interstate 5 highway culverts which are connected to pipes that discharge into the landfill. Water quality parameters will be analyzed as described in the revised final RI Sampling & Analysis Plan.

Water levels at ponds and seeps identified during the field investigation activities will be measured on a regular basis during the intensive monitoring period as determined by the overall work plan schedule. Samples will be obtained as appropriate based on water levels and antecedent conditions and analyzed for the presence of selected indicator pollutants. Hydrologic data associated with surface water run-on will be obtained from onsite climatological instruments as described in Task 3.3. Monitor well samples and water levels obtained for wet weather conditions will be coordinated with stormwater sampling events to gain insight into overall landfill area water balance.

2.3.5 TASK 3.5 SOILS SAMPLING

Soils samples will be collected at selected offsite seep locations where contaminated leachate is found. The upper two feet of soil will be the collection zone and several soil cores from the contaminated area will be composited to provide one homogeneous sample per site. Soil samples will be extracted in the laboratory and analyzed for parameters of interest based on leachate characterization at the soil sample site. Soil samples will be collected during routine inspections of offsite seeps which are determined to be contaminated.

2.4 TASK 4.0 DATA ANALYSIS AND REPORT PREPARATION

The purpose of this task is to analyze and interpret the multi-media data base obtained during the remedial investigation field activities and monitoring program, develop conclusions and recommendations regarding receptor impacts from offsite migration of landfill contaminants, and prepare technical and project reports which summarize the completed work efforts and estimate additional levels of effort necessary to define the nature and extent of particular problem issues. Conclusions and recommendations for further remedial investigation activities will be detailed including plans for further monitoring of installed groundwater/leachate wells, gas probes, ambient air, and surface water. Recommendations will also be provided regarding implementation of a remedial action feasibility study for Midway Landfill.

2.4.1 TASK 4.1 DATA ANALYSIS AND INTERPRETATION

The purpose of this task will be to analyze and interpret the data obtained from the field activities. The utilization of an established data management system (described in Task 6.0) will allow for the efficient, accurate analysis of generated data. The data analysis will include statistical analysis of each data type in accordance with the procedures outlined in the Midway Landfill Quality Assurance Plan. Statistical correlations of selected data groups will be performed (e.g., correlations between strata permeabilities and gas concentrations) to assist in developing assessments of current conditions and predictions of future conditions. During this task, data action level criteria will be developed for assessing the need for additional data, defining extent and magnitude of contamination, and/or implementing remedial actions.

The output from this task will consist of data summaries, data plots, data statistical correlations, and other items which describe numerically and mathematically the field activities and the monitoring activities completed in accordance with this work plan. Data analysis results will be used to describe as accurately as possible the current conditions within and near the landfill.

Data analysis efforts will include historical long term climatological data assessment, primarily wind direction and velocity and precipitation, and additional ambient air model development and refinement to better define "worst case" atmospheric conditions. Also, groundwater and leachate hydraulics will be described using mathematical relationships and spatial relationships obtained from the initial remedial investigation groundwater data base.

2.4.2 TASK 4.2 PROJECT REPORTS

A series of technical reports will be generated from the individual field and monitoring activities and data analysis conducted during the RI Project Work Plan implementation. These will be generated as separate documents as work tasks are completed. Information from these individual reports will be utilized in a synoptic manner to conduct further data analysis, plot or draw maps, and reach conclusions regarding remedial investigation objectives. A summary report will be developed at the end of the data analysis and interpretation task which incorporates the individual technical reports as chapters and summarizes the remedial investigation with appropriate verbal or graphic outputs. The summary report to be produced as a result of this task is described below as a separate subtask. A preliminary table of contents for the summary report is attached as Table 4-1.

2.4.2.1 TASK 4.2.1 PROJECT SUMMARY REPORT

An overall summary report will be prepared to present a comprehensive and synoptic review of all RI activities to date. The primary objectives of this report will be (1) synoptic review of all field data,(2) identification of further field data collection needs (3) updated status of offsite surface or subsurface pollutant migration problems including identified receptor populations, and (4) conclusions and recommendations for further remedial action efforts. The report will be organized into major issues discussions using the established data base and individual project technical reports to summarize status of the following issues: gas migration, leachate migration, offsite groundwater contamination, offsite air quality degradation, overall water balance and drainage, and offsite receptor impacts. The project summary report will include an executive summary section suitable for public distribution and fact sheet development. Individual technical reports generated during the remedial investigation will be incorporated into the project summary report as chapters as follows:

TABLE 4-1. REMEDIAL INVESTIGATION REPORT FORMAT

EXECUTIVE SUMMARY

1.0 INTRODUCTION

- 1.1 SITE BACKGROUND INFORMATION
- 1.2 NATURE AND EXTENT OF PROBLEM (S)
- 1.3 REMEDIAL INVESTIGATION SUMMARY
- 1.4 OVERVIEW OF REPORT

2.0 SITE FEATURES INVESTIGATION

- 2.1 DEMOGRAPHY
- 2.2 LAND USE
- 2.3 NATURAL RESOURCES
- 2.4 CLIMATOLOGY

3.0 HAZARDOUS SUBSTANCES INVESTIGATION

- 3.1 WASTE TYPES
- 3.2 WASTE COMPONENT CHARACTERISTICS AND BEHAVIOR

4.0 HYDROGEOLOGIC INVESTIGATION

- 4.1 SOILS/GEOLOGY
- 4.2 GROUND WATER

5.0 SURFACE-WATER INVESTIGATION

- 5.1 SURFACE WATER
- 5.2 SEDIMENTS
- 5.3 FLOOD POTENTIAL
- 5.4 DRAINAGE

6.0 AIR INVESTIGATION

- 6.1 CLIMATOLOGICAL PATTERNS
- 6.2 CONTAMINANT QUANTIFICATION

7.0 RECEPTOR INVESTIGATION

- 7.1 POPULATION PATTERNS
- 7.2 FLORA/FAUNA

8.0 PUBLIC HEALTH AND ENVIRONMENTAL CONCERNS (PRELIMINARY ENDANGERMENT ASSESSMENT)

- 8.1 POTENTIAL RECEPTORS
- 8.2 PUBLIC HEALTH IMPACTS
- 8.3 ENVIRONMENTAL IMPACTS

REFERENCES

APPENDICES

o Hydrogeologic Investigation

This chapter will describe the geotechnical and geologic information generated during the installation of the monitoring wells and gas probes. Incorporated into this report will be the results obtained from the soil sampling effort. Standard stratigraphic logs and lithographic descriptions will be included in the chapter. Also included will be geologic cross-sections defining the study area stratigraphy graphically, and plots prepared from the ground survey activities indicating relative locations and elevations. Data from the leachate and groundwater monitoring program will be presented and assessed with respect to rate and direction of movement and quality.

o Gas Migration Investigation

A chapter of the summary report will summarize the results obtained during field and laboratory-generated monitoring of the gas probes. A summary of gas concentrations will be presented. Further assessment of the effectiveness of the gas collection system will be made. Spatial and temporal gas relationships will be further described, and isopleths of gas concentrations will be prepared on base maps. Statistical regression correlations of data will be completed to improve the gas migration data base interpretations and gas migration model. Additional at-risk areas will be identified, if appropriate. The gas migration summary report will build on and summarize earlier gas related reports including (1) the shallow gas probe monitoring report completed in February, 1986, and (2) a comprehensive update to the initial gas monitoring report to be prepared under a separate work assignment.

o Meteorological/Air Quality Investigation

The results of the ambient air/meteorological monitoring will be compiled and presented in an appropriate format. Discussion and plots derived from outputs and predictions of selected air quality model executions will be included. Results will be compared to regulatory limits for those compounds for which ambient air limits exist. Recommendations for additional monitoring, if needed, will be made. Ambient air quality impacts on potential receptors will be assessed with regard to worst case meteorological conditions. Source emissions from the gas control system and diffuse gas emission surveys will be analyzed with respect to system efficiency and ambient air impacts.

o Surface Water Investigation

The data obtained during the surface water investigation will be compiled in a report format. The amount of rainfall and run-on will be summarized, and comparison of the values obtained will be made with previously calculated amounts. The necessity of rerouting surface drainage away from the landfill will be assessed. An overall hydrologic balance will be described based on data obtained to date and closure options for surrace water as described in the Midway Landfill Environmental Impact Statement (City of Seattle, August, 1985). Data for ponds and seeps will be summarized with respect to surface and groundwater interactions.

o Receptor Investigation

The receptor populations identified during the course of the field activities will be described. The populations will be described according to paths of contaminant exposure including air, water, and soil. Included in the assessment will be physical resources (residences, businesses, transportation patterns, utility layouts, etc.), wildlife and aquatic resources, and vegetation. The primary method utilized to define potential exposure limits will be geographic overlays of receptor populations and pollutant pathways on study area base maps. These plots will provide sufficient detail to establish geographic limits for additional RI field or monitoring activities.

2.5 TASK 5.0 FEASIBILITY STUDY PROJECT WORK PLAN

The feasibility study project work plan for the Midway Landfill site will include the following major tasks in accordance with EPA guidance: Problem Definition, Identification of Remedial Alternatives, Initial Screening of Alternatives, Laboratory and Engineering Studies, Evaluation of Remedial Alternatives, Preliminary Report, Conceptual Design, and Final Report.

2.5.1 TASK 5.1 DEVELOP FEASIBILITY STUDY WORK PLAN AND BUDGET

Appendix A to this RI Project Work Plan includes a detailed outline for the proposed feasibility work plan including each of the above listed tasks. Each of these tasks will be detailed during work plan development and manpower and budget estimates prepared for completion of each task effort. A draft feasibility study work plan document will be prepared and submitted for Ecology review. Upon receipt of comments and resolution of budget details, a final feasibility study project work plan document will be submitted to Ecology for approval. At that time, implementation of selected tasks of the work plan will be initiated.

2.5.1 TASK 5.2 IMPLEMENTATION OF SELECTED GAS MIGRATION FEASIBILITY STUDY TASKS

Portions of the foregoing tasks have been initiated, primarily concerning the remedial alternatives relating to control of landfill gas migration. Problem definition for the gas migration issue is being addressed in detail for the "hot zone" to the east of the landfill as a major separate work assignment. offsite gas extraction wells have been installed as a significant remedial measure for controlling offsite gas emissions, and evaluations of those extraction systems, including emissions controls, are currently being addressed. Other gas control options can appropriately be addressed under this task to complete the preliminary stages of the feasibility study and shorten the schedule for remaining gas migration issues. Those portions of the feasibility study work plan relating to the gas migration issue and initiated under other work assignments will be completed under this task. Completion of additional feasibility study work plan tasks will be undertaken as a separate work assignment upon completion of the RI field investigation.

2.6 TASK 6.0 PROJECT ADMINISTRATION

Project administration during the implementation of the RI Project Work Plan will represent a significant work effort due to the expected number of field activities, the requirement to coordinate schedules, the need to manage task budgets closely, and the expected number of subcontracts. Project administration wil be divided into three separate work efforts, including project management activities, data management activities, and subcontract document preparation.

2.6.1 TASK 6.1 PROJECT MANAGEMENT ACTIVITIES

Project management will be an ongoing task throughout the proposed work effort. Management activities are expected to include management of staff assignments and budgets, participation in staff or public meetings, preparation of monthly status reports, subcontractor supervision, contract management activities, and data management. Management of the remedial investigation schedule for field activities and monitoring will be a major project management task in this work plan due to the large number of interrelated simultaneous tasks. Staff assignments and organization and subcontract management will also be significant management efforts during work plan implementation.

2.6.2 TASK 6.2 DATA MANAGEMENT

Data management will be an important project management function for the Midway Landfill remedial investigation effort. A large and diverse data base will be created by field and monitoring activities. Historical and existing data collection efforts have also resulted in a large amount of data which needs to be placed in a manageable format. The following items will be addressed during the implementation of the data management task:

- o Ecology data management format requirements
- o Data types and quantity (historical and projected)
- o Types and volumes of associated data (climatic, geological, water

quality, ambient air, gas probe, potable water)

- o QA plan requirements

- o Computer data base and mathematical model format requirements

- o Data security requirements (confidentiality)

The updated data management system will contain files that are properly categorized, quality assured, and will include all data attributes (i.e. mean, median, mode, standard deviation). The data management system files will be accessible to qualified personnel for use in development of contamination assessment (extent and magnitude), the preparation of summary reports, and identification of additional data needs. All relevant historical data and data developed during RI field investigation activities will be reviewed for data base input, entered into the data base, and each data record verified.

2.6.3 TASK 6.3 DEVELOPMENT OF SUBCONTRACT DRAWINGS, SPECIFICATIONS AND CONTRACT DOCUMENTS

The purpose of this task is to develop plans, drawings, and specifications for the drilling program, ground survey activities, and specialty air quality instrumentation installation, startup, and consultation. The format used will be suitable for each type of subcontract, and will meet all contract procurement requirements of EPA, the State of Washington, and the Black & Veatch prime contract with Ecology. B&V will develop all contract documents and will assist Ecology in completing procurement requirements. Contents of the documents will include:

- o Typical drawings for monitor well, leachate well, and gas probe installation with appropriate design notes and specification references.

- o Specifications for all drilling activities including mobilization, drilling procedures, geologic sampling procedures, casing installation and grouting details, and completion details.

- Specifications for ground survey activities including tolerances for horizontal and vertical surveys, computational and field note methods, instrument tolerances, and map plotting requirements.

- Specifications for air quality monitoring instrumentation installation and startup, including instrument specifications, operating environment, power requirements, support equipment requirements, and maintenance requirements.

- General contract clauses, including health and safety, quality assurance and quality control, insurance, and administrative requirements.

- Bid forms for submission of subcontractor quotes where appropriate.

Ecology will review the draft contract documents for compliance with all technical and procurement requirements. After Ecology approval is obtained, final contract documents will be used to retain one or more specialty subcontractors for the required scope of work.

2.7 TASK 7.0 COMMUNITY RELATIONS

Activities identified in the Midway Landfill Community Relations Plan will be implemented during this task. Specific efforts will include preparation of fact sheets for public distribution, a pre-activity public meeting, post-activity public meeting, and condensed summaries of the results obtained during the field investigation.

3.0 PROJECT SCHEDULE

Figure 3-1 describes the proposed remedial investigation schedule. Work plan implementation is expected to begin during April or May, 1986 and will extend for approximately 52 calendar weeks. Schedule matters will be detailed further during project initiation activities to be conducted during the first two weeks of work plan activity.

FIGURE 3-1
RI PROJECT WORK PLAN SCHEDULE

WEEKS AFTER NOTICE TO PROCEED

```
TASK                          0   2   4   6   8   10  12  14  16  18  20  22  24  26  28  30  32  34  36  38  40  42  44  46  48  50  52

1.0 PROJECT INITIATION        MXXXXXXXX

2.0 FIELD ACTIVITIES                   FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

2.1 GW WELL INST                           FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
2.2 LEACH WELL INST                                   FFFFF
2.3 GAS PROBE INST                         FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
2.4 GROUND SURVEY                                                     FFFFFFFF
2.5 SURFACE WATER INST                                FFFFF
2.6 AIR QUALITY INST                   FFFFFFFF                               FFFF    FFFF    FFFF
2.7 RECEPTOR SURVEY                                   FFFFF

3.0 MONITORING ACTIVITIES                     FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

3.1 GW/LEACH MONITORING                       FFFFF                       FFFFF               FFFFF                   FFFFF
3.2 GAS PROBE MONITORING      F--ONGOING UNDER SEPARATE WORK ASSIGNMENT--F        FFFF    FFFF    FFFF   FFFF    FFFF
3.3 EMISSION MONITORING                aaaaaaaaaaaaaaaadddddaaaaaaaaaaaaabbbbaaaacccccddddccccbbbbcccc
3.4 SURFACE WATER MON                                     FFFFF  fg f  fg f  fgFFFFfg f  fg f  fg f  fg f  fg f  fg f  fg f  fg f
3.5 SOILS SAMPLING                                                                    g     g     g     g     g     g     g     g

                              0   2   4   6   8   10  12  14  16  18  20  22  24  26  28  30  32  34  36  38  40  42  44  46  48  50  52

4.0 DATA ANALYSIS/REPORTS                                 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

4.1 DATA ANALYSIS                                         XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
4.2 REPORTS                                                    m   m   m   m   m   m   m   m   m   m   m   m   m   m   mrrrrrrrrrrrrrrr

5.0 FEASIBILITY FWP                                                                                                   XXXXXXXXXXXXXXXXXXXXXXXXX

5.1 DEVELOP FWP/BUDGET                                                                                                XXXXXXXXXrrrr
5.2 IMPLEMENT FWP TASKS                                                                                                           XXXXXXXXXrrrr

6.0 PROJECT ADMIN             XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

6.1 PROJECT MGMT              MXXXXXXXXXXXXXXXXXXXXXXXXXMXXXXXXXXXXXXXXXXXXXXXXXMXXXXXXXXXXXXXXXXXXXXMXXXXXXXXXXXXXXXXXXXXXMXXXXXXXXXXX
6.2 DATA MGMT                                             XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
6.3 SUBCONTRACTS              XXXXXXXD                            XXXXXXXD

7.0 COMM RELATIONS            MXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXMXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXMX

                              0   2   4   6   8   10  12  14  16  18  20  22  24  26  28  30  32  34  36  38  40  42  44  46  48  50  52
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SCHEDULE LEGEND:

X = Ongoing Admin Activity	F = Ongoing Field Activity	M = Staff or Public Meeting
m = Project Memoranda	r = Project Reports	D = Contract Documents
a = On-Site Air Monitoring	b = Gas Control System Monitoring	c = Off-Site Air Monitoring
d = Diffuse Gas Monitoring	f = Surface Water Measurements	g = Seep/Soil Measurements

APPENDIX A

OUTLINE OF FEASIBILITY STUDY PROJECT WORK PLAN
MIDWAY LANDFILL REMEDIAL INVESTIGATION

1.1 TASK 1.0 PROBLEM DEFINITION AND DESCRIPTION OF PROPOSED RESPONSE

1.1.1 Site Description

A summary of the information collected for the Midway Landfill site which will include site history and background, site conditions, nature and extent of contamination, actual and potential hazards, affected media, pathways of exposure and conditions warranting mitigation and remediation will be prepared. This description will form the basis for developing the overall purpose and approach to remedial actions at the site.

1.1.2 Purpose

The statement of purpose will identify each aspect of the problems at the site and define respective approaches. At the Midway Landfill site, the statement of purpose will include:

- o Mitigation of landfill gas migration
- o Control of contaminated groundwater to protect drinking water supplies
- o Control of contaminated soils on-site
- o Control of potential surface water runoff
- o Excavation and removal of subsurface containers, drums and other debris (i.e., capacitors) if discovered in the RI and found to be hazardous to public health and environment

1.1.3 Endangerment Assessment

An endangerment assessment will be performed to determine the magnitude and probability of actual or potential harm to the public health, welfare, or the environment by the threatened or actual release of hazardous substances at the site. The endangerment assessment will evaluate the collective demographic, geographic, physical, chemical, and biological factors which describe the extent of the impacts of a potential or actual release of hazardous substances from the site. The endangerment assessment will identify and characterize the following:

(1) Chemicals or mixtures present in all relevant environmental media
(2) Environmental fate and transport mechanisms within specified environmental media, including hydrogeological evaluations and assessments
(3) Intrinsic toxicological properties of specified substances
(4) Exposure pathways and extent of expected exposure
(5) Populations at risk
(6) Extent of expected harm and the likliehood of such harm occuring (risk characterization)

Each of these areas is described below.

1.1.3.1 Hazardous Substances at the Site. The type of substances present at the site as identified during the RI will be summarized. The individual physical and chemical properties of the hazardous substances identified at the site influence how they will migrate from the site and impact receptor populations. The important physical and chemical properties will be tabulated for use in the analysis of the efficiency of remedial action alternatives and estimating the time required for self-cleaning under a no-action alternative.

1.1.3.2 Environmental Fate and Transport Mechanisms. The probable fate and transport mechanisms within the specified environmental media will be summarized. Part of this assessment will include hydrogeological evaluations and assessments to determine the likelihood of hazardous substance leaving the site via ground or surface water. Geologic and metrological impacts will be assessed. A summation of pertinent substance's physical properties will be made, as well as susceptability to biodegradation/biotransformation processes. By combining the information with site-specific geological and hydrogeological information, a prediction can be made of the presence, persistence, and transport of substances at the site.

1.1.3.3 Routes of Exposure. The routes of exposure describe the various pathways by which the population at risk may become exposed to the site's hazardous substances. Typical routes of exposure include surface water, groundwater, airborne vapor and particulates and direct contact. Each route of exposure will be evaluated to assess its potential for exposing humans as well as aquatic and terrestrial species to hazardous wastes.

1.1.3.4 Population at Risk. Each of the specific populations will be identified which are potentially exposed to hazardous wastes at or migrating population, size, route of exposure, level of exposure, and the projected duration (acute or chronic) will be identified.

1.1.3.5 Impact Evaluation. The effects of a discharge of a hazardous substance upon public health, welfare, or the environment will be established using both direct and indirect evidence. Direct evidence reflects observed effects on target species, and indirect evidence reflects the presence of toxic chemicals at levels associated with such observed effects. The impact evaluation will include an assessment of qualitative exposure levels, as well as the assessment of qualitative risk. A qualitative assessment includes review of all pertinent ecological and health science information, followed by an evaluation of existant scientific and technical data. A risk assessment is useful in providng information concerning potential health hazards in situations where specific groups of people are exposed to particular toxic substance at the waste sites.

1.1.3.6 Pertinent Criteria for Permissible Exposure. There are a variety of criteria or standards relating to permissible exposure to hazardous substances including water quality criteria published by EPA, as well as water quality standards generated by the EPA Office of Drinking Water. The quantitative risk assessments for the priority pollutants conducted by the EPA Office of Water Regulation and Standards also provide information on permissible exposure to hazardous substances via waterborne pathways. Other information sources include reports published by the EPA Carcinogen Assessment Group. Each of these sources as well as other data on the suggested no adverse response levels (SNARL), the no observed effect level (NOEL) and other measures of toxicity will be included in the criteria assembled to evaluate permissible exposure for compounds for which no standards exist.

1.1.3.7 Comparision of Receptor Exposures to Criteria and Standards. The individual receptor exposures will be evaluated to determine the total dose which could be received from all exposure pathways. This dose will then be compared with the various criteria and standards which are available for evaluating the permissible exposures to hazardous substances. A comparision of the dose received by the receptor with the permissible exposure provides a basis for examining the public health and environmental risk associated with the exposure to hazardous waste materials.

1.1.4 Endangerment Report

With the available information the endangerment assessment will evaluate the adequacy, accuracy/precision, comprehensiveness, reliability and overall quality of identified information and data. This evaluation will use the following outline and use qualitative and/or quantitative terms as appropriate.

(1) Physical Description of the Site and Site History
- a. geographic location
- b. management practices/site use/site modifications
- c. chronological survey
- d. facility description/containment systems
- e. substances brough on site (identify, quantity, manner of disposal)

(2) Site Contamination/Offsite Contamination
- a. identify substances detected
- b. concentration of substances detected
- c. analytical methodology and QA/OC
- d. survey of environmental monitoring studies (detailed discussion of environmental media and contamination levels)

(3) Environmental Fate and Transport
- a. physical-chemical properties of specified chemicals/substances (e.g., soil/sediment adsorption coefficients, vapor pressures, solubility, etc.)
- b. photodegradation rates, decomposition rates, hydrological rates, chemical transformations, etc.
- c. local topography
- d. description of the hydrological setting and flow system
- e. climatic factors, other factors affecting fate and transport
- f. prediction of fate and transport (where necessary using

modeling methods)

(4) Toxicological Properties (hazard identification)
   a. metabolism
   b. acute toxicity
   c. subchronic toxicity
   d. chronic toxicity
   e. carcinogenicity
   f. mutagenicity
   g. teratogenicity/reproductive effects
   h. other health effects as relevant including neurotoxicity, immuno-depressant activity, allergic reactions, etc.
   i. epidemiological evidence (chemical specific or site specific)
   j. aquatic/non-human terrestrial species toxicity/environmental quality impairment

(5) Exposure Assessment
   a. demographic profile of populations at risk including subpopulation at special risk
   b. background chemical exposures
   c. life style and occupation histories
   d. population macro- and micro-environments
   e. exposure routes
   f. magnitude, source, and probability of exposure to specified substances

(6) Risk Assessment and Impact Evaluation
   a. carcinogenic risk assessment
   b. probability of non-carcinogenic human health effects
   c. non-human species risk assessment
   d. environmental impacts/ecosystem alternations

(7) Conclusions

Appendices

1.1.4.1 Establishment of Site Specific Remedial Response Objectives and Criteria. Site-specific remedial response objectives will be established based on the definition of the problem, proposed approach and risk assessment for the site. The objectives will identify for this site the minimum acceptable extent of remedy such that "adequate protection of public health, welfare or the environment" is achieved, according to Section 300.68 of the National

Contingency Plan.

1.2 TASK 2.0 IDENTIFICATION OF REMEDIAL ALTERNATIVES

Considering the remedial response objectives for the site, a limited number of alternatives will be identified, including source control, offsite actions, and on-action alternatives. Each alternative will consist of individual remedial technologies combined to form a comprehensive plan for addressing all of the remedial response objectives for the site. Table 5-1 lists some remedial technologies which may be applicable to the Midway Landfill site.

1.3 TASK 3.0 INITIAL SCREENING OF ALTERNATIVES

In order to narrow the list of potential remedial actions at the site and to focus resources on the most likely alternatives, an initial screening of the alternatives developed in Task 5.2 will be performed. This screening will be based on general descriptions of the alternatives and will consider four broad criteria: effects and benefits of the alternatives, cost, engineering suitability and institutional factors. The alternatives will be evaluated according to these criteria at a conceptual level in order to eliminate alternatives which clearly appear unlikely to meet the requirements of CERCLA and the NCP for selection of the most cost-effective alternative.

1.3.1 Effects and Benefits of the Alternative

The candidate alternatives will be considered in terms of (1) the potential environmental or public health impacts of the alternatives or their implementation and (2) their ability to provide adequate protection of public health, welfare, or the environment as defined by the remedial response objective.

1.3.2 Cost

The objective of the cost screening is to eliminate those alternatives whose costs are significantly greater than other alternatives yet do not provide substantially greater environmental or public health benefits.

Cost opinions will be developed for each alternative, including capital costs and operation and maintenance costs. Costs will be developed using readily available information including standard cost references, EPA and other reports on remedial action costs, and previous experience. Accuracy of the opinions will be -25 to +25 percent. The project team will utilize consistent, well-documented data sources and estimating procedures to ensure that the cost opinions can be reasonably compared.

Following development of cost opinions for each alternative, the team will compare the costs and relative benefits of the alternatives. If costs of any alternative are an order of magnitude greater than other alternatives offering similar environmental and public health benefits, the costly alternative will be eliminated from further consideration.

1.3.3 Engineering Suitability

The evaluation of engineering suitability will be based on engineering judgement, available information, and experience with the remedial technologies comprising each alternative. Factors in this analysis include reliability, implementability, technical feasibility, applicability to site conditions, and time period for achieving remedial objectives. Alternatives which are significantly deficient relative to any of these criteria will be eliminated from further evaluation.

1.3.4 Institutional Factors

Institutional issues must also be analyzed to ensure that remedial alternatives are consistent with applicable statutes, regulations, and policy under federal, state, and regional jurisdiction. Specific issues to be addressed will include offsite transport, relocation of residents, regulatory requirements and coordination (including NEPA EIS requirements and functional equivalency), and community relations.

1.4 TASK 4.0 LABORATORY AND ENGINEERING STUDIES

The purpose of laboratory and engineering studies is to evaluate the site-specific effectiveness of a limited number of proposed technologies. Such testing yields information on the permeability or compatibility of various proposed materials with the wastes, or the effectiveness of different methods of treatment of various wastes. For instance, at the Midway Landfill site, studies may need to be conducted relative to the type of treatment required to remove contaminants from groundwater or to evaluate the efficiency of trace hydrocarbon destruction during flaring of collected landfill gases. The types of tests which may be conducted under this task include:

- Treatability Studies

- Pilot Scale Studies
- Compatibility Testing
- Specification Testing
- Environmental Testing

1.5 TASK 5.0 EVALUATION OF REMEDIAL ALTERNATIVES

Based on the results of the RI and prior tasks of the Feasibility Study, thorough technical and performance analysis of the candidate technologies will be made. In this task a relative ranking of the technologies will be conducted. Criteria for ranking will include:

- Environmental impact
- Operations and maintenance
- Off-site disposal and transportation needs
- Safety requirements
- Reliability
- Implementability
- Probable Cost
- Regulatory requirements and public acceptance
- Cost-effectiveness

1.6 TASK 6.0 PRELIMINARY REPORT

The results of Tasks 3.1 through 3.5 will be documented in a preliminary feasibility study report, highlighting all relevant factors that lead to the recommendation of the cost-effective alternative. The following list describes the major sections of this report:

- Executive Summary
- Overview of Remedial Investigation
- Remedial Response Objectives and Evaluation Criteria
- Identification of Remedial Alternatives
- Results of Screening Analysis
- Results of Laboratory Studies
- Evaluation of Candidate Alternatives

This report will be submitted to Ecology, and Ecology approval of the recommended alternative will precede any detailed work on the Conceptual Design. This report will also serve as a draft to the final report.

1.7 TASK 7.0 CONCEPTUAL DESIGN

A preliminary conceptual design of the alternatives will be prepared upon Ecology approval of the draft report. The conceputal designs will include preliminary design criteria, approximate costs, implementation requirements, operation and maintenance requirements, safety plan and institutional or legal requirements. The conceptual designs will provide the basis by which further design may be accomplished without additional data collection. Permits that may be necessary for design implementation will also be identified. These may be required from entities such as USEP's NPDES program, state and federal transportation agencies, and local agencies regulating zoning and land utilization.

The degree of engineering detail of the conceptual designs will depend on the remedial alternative selected and will vary with the technologies involved. However, the design report will have sufficient detail to allow an Ecology A/E contractor to prepare plans, specifications, and contract documents.

The design basis of the selected remedial alternatives will include basic design criteria and narrative, layouts, and an implementation schedule for its various components. Refined sketches and schematic drawings to document the preliminary engineering approach will be included, along with preliminary design specifications for preparation of detailed design, plans, and specifications. The design basis will also include the following: 1) phasing and segmenting considerations; 2) management and institutional considerations; 3) special implementation considerations; 4) operation and maintenance considerations; 5) an outline of the safety plan including cost impact on implementation; 6) utility requirements; and 7) transportation considerations, if needed. A special section will address the requirements posed by interfacing of the remedial activities with the public. A design report for each alternative will be prepared and will include the following sections:

- Site Features Affecting Design
- Technological Features Affecting Design
- Summary of Selected Alternative
- Design/Implementation Precautions.

1.8 TASK 8.0 FINAL REPORT

A final report on the results of Tasks 5.1-5.7 will be prepared and submitted to the Department of Ecology. The report will include the detailed results of the feasibility study with supporting information in the appendices. The proposed final report outline will follow that of the Preliminary Report including a section for Conceptual Design and include any revisions and comments made by Ecology.

1.9 TASK 9.0 PROJECT ADMINISTRATION

2.0 TASK 10.0 COMMUNITY RELATIONS

TABLE 4-1 POTENTIAL REMEDIAL TECHNOLOGIES

Media	Goal of Remedial Response	Remedial Technologies
Gas Migration	Control migration of methane	Collection system Beneficial reuse Infiltration control Expand methane curtain Capping
Surface water	Control runoff, infiltration, redirection of surface flow, slope, erosion potential, flood hazard, runon	Capping Grading Revegetation Dikes and berms Ditches, diversions, and waterways Chutes and downpipes Levees
Groundwater	Remove, control, or contain migration of contaminated groundwater	Capping Groundwater pumping (interceptor wells) Treatment of groundwater
Onsite wastes and contaminated soil	Remove, contain, treat, or dispose of hazardous materials	Soil excavation transport Disposal In-situ treatment Isolation (Solidification/Encapsulation)